OCT 16 1926

October 14, 1926

Engineering News-Record

Devoted to Civil Engineering and Contracting.
McGraw-Hill Publishing Company, Inc.

Beginning—

A SERIES OF ARTICLES ON

The Civil Engineer in Industry

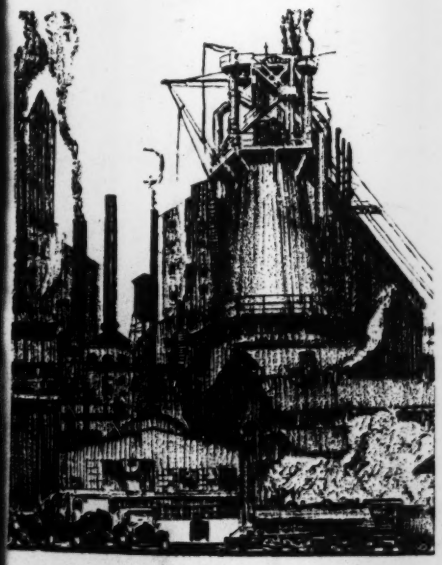
IN THIS ISSUE

PLANT ENGINEERING—*A little understood field*

Not Management, *Not* Production

Not Efficiency Engineering—

But a Civil Engineering Operation in the Broadest Sense



TO COME

—Executive Engineering

—Industrial-Municipal Engineering

—Industrial Staff Engineers and Constructors

Federal Roofs

link light weight with High Strength

WHEN you roof with Federal Cement Tile, you effect substantial savings on the steel super-structure or frame.

That is due to Federal Tile's light weight.

Because these pre-cast slabs are quality controlled, accurately reinforced with wire mesh, and thoroughly cured under uniform temperature conditions, they link this light weight with high strength.

And you are sure of the same permanent freedom from repairs that Federal Roofs have been providing on industrial and public buildings of every type for a quarter of a century.

Made of concrete, these roofs are fire-proof and rust-proof. They are also freeze-proof and sun-proof. They are unaffected by gases, by smoke, or by acid fumes.

Let us tell you the full story of Federal Roofs, and of the engineering and erection service that goes with them. Your request will be given prompt, courteous attention without placing you under any obligation.

Federal Interlocking Tile for pitched surfaces have a non-fugitive, red color and require no painting. When used with Federal Glass Insert Tile for top-lighting an ideal "daylight roof" is obtained. Other styles include Flat and Channel Slabs for roof decks

Made, Laid and Guaranteed by the

FEDERAL CEMENT TILE COMPANY

608 South Dearborn Street, Chicago, Illinois

FEDERAL CEMENT TILE ROOFS

"For Every Type of Permanent Building"

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

FRANK C. WIGHT
Editor

Volume 97 NEW YORK, OCTOBER 14, 1926 Number 16

Wider Usefulness

TOO FREQUENTLY we think of civil engineers as running surveys, designing waterworks and building bridges. Structures and public services are thought to be their only field and the widening opportunities of industrial operation are assumed to belong to those engineers whose training and practice are in the mechanical sciences. To combat that view the series of articles beginning in this issue is offered. Consideration of the facts presented in this series will be valuable not only to the civil engineer himself, as a possible opening for his services, but also to those who have in charge the education of the civil engineer.

Stupidity

FOR SOME years it has been the custom at the annual meeting of the American Federation of Labor to open the pulpits of the local churches to the labor leaders there assembled. There is no record that any of the lay sermons so provided have been subversive of law and order or, for that matter, any more effective than the more authoritative offerings of the usual Sabbath. In Detroit last week, however, capital and management took fright. The open-shop automobile factories were threatened with the dangerous doctrine of unionism and so the church and the allied Y. M. C. A., submissive to the city's ruling industry, refused the privilege of the pulpit and the platform to the meeting laborites. In consequence, what might have been a mild dose of unpleasant propaganda has been transformed into a country-wide outcry against narrowness and abuse of power and the campaign for unionized labor in the automobile shops is launched under the favoring impetus of oppression. Against stupidity the gods cry out in vain.

The Contractors Develop Organization Skill

DEFINITIVENESS of attack is being developed as organized contracting becomes educated in the task of association work. This is a greater stride ahead than is realized by the commonality of the membership of the Associated General Contractors or even, perhaps, by the active workers a little group of which assembled for association business last week in Kansas City. The contractors who answered the first convention call in Chicago eight years ago gathered with a keen sense of griefs to be eliminated and of aspirations to be realized but with no very clear idea of causes, no determined methods of work and indeed no very definite objectives. There was multiplicity of council. Contractors widely had never before worked in concert, it was even prophesied freely that they never could. The association began work. Fortunately there was a wise decision at the start. A paid directing and working staff was organized to head up committee activities. Naturally the staff "found" itself before the generality of the membership did. Gradually the members have acquired definite purpose and procedure. This, we repeat, was particularly in evidence at the Kansas City meeting. There the proceedings gave clear evidence that the association knows how to investigate an operation and how to estimate the effort that must be put into the task and keeps clearly before itself the plans and specifications of its objective. Specifically, this ability was evidenced in developing the line-up against day labor activities, for surety bonding reform and for sound quantity survey practices. There is not space to name other important work being undertaken. The point to be made clear is: the Associated General Contractors—staff and committees—know how to work—have not merely the disposition to work but also the skill to work efficiently and effectively. This is surety to the membership that funds provided for association activities will bring constructive results.

An Example of Courage

THE news dispatches have been less than fair to the storm-swept region of southern Florida. Practically nothing has been printed to tell whether the people there have been doing anything to dig out of the wreckage, restore order and recreate the beauties that charmed so many thousands. Let it be said here, therefore, that they met their responsibilities in praiseworthy manner. With unimpaired courage they took hold of relief and rehabilitation, displaying remarkable resources of energy and organizing ability in carrying out the task. This is the report brought back from Miami by *Engineering News-Record's* staff representative, and is confirmed by G. R. Solomon's account of how Fort Lauderdale worked to get back on its feet. There was, of course, quick and invaluable aid from outside: The state health authorities jumped in, cities and individuals everywhere sent supplies, equipment and money, a Chicago newspaper on the first word of the disaster dispatched a medical relief train, the Red Cross put its whole organization into the work, and so on; yet, chief credit must go to the local people themselves for their grit and hard work. This applies equally to public officials, to corporations such as railroads and utilities, and to individual citizens. What makes the spirit of the people the more impressive is the fact that just before the storm they were in the doldrums of discouragement. Deflation from last year's mad boom had told heavily on them, and the summer lag of business intensified the effect. They were looking anxiously for an upturn with the approaching winter—and then the great storm came down upon them with a smashing blow. It was under the seemingly hopeless circumstances that they showed their grit. Such display of courage is proof that, so far as it depends on the spirit of its people, the future of southern Florida is secure.

Sub-Base Hazard

GRANULAR sub-base for concrete pavement on clay soil is proving frequently to be a hazard instead of a safeguard, particularly in city paving. As one engineer in a northern city puts it the sand or cinder layer serves as a means of irrigation instead of as a means of drainage and is a cause of frost displacements and not a preventive. It is easily understandable how such a condition would prevail with the porous material occupying virtually a trench in the clay subgrade, as might be quite likely in city paving even with the tile side drains back of the curb. On rural roads the open side ditches and the practicability of lateral extension into the shoulders of the sub-base layer make less likely collection of water in the porous bed and consequen. increased heaving by frost. Occasional experience of disastrous heaving due to sub-base ponding has raised the problem, and while perhaps not of major importance, it at least suggests looking well after possible drainage methods.

Where the Money Goes

EVERY new installment of Census Bureau figures on the cost of government gives rise to comments and questions the character of which depends upon the commentator. Most of the thoughts expressed turn on "the mounting cost of government." Few concern themselves with the question, "Where does the money go?" Fewer yet consider the still unsatisfied demands in the various fields and their reasonableness. The latest Census figures on government costs deal with our 48 states, and are confined to preliminary summaries. Leaving out of consideration here comparisons with earlier years and with federal outgo let us see how the $1,035,478 classed as "expenses for operation and maintenance of general departments" for 1925 are divided. Rearranging from greatest to least the totals under nine heads, and giving first the items in millions of dollars, then in dollars per capita and finally in percentages of the total we have: Education, 397.7: 3.53: 38.4 (including 250 million allotted to minor civil divisions); charities and corrections, 168.8: 1.50: 16.3; highways, 144.3: 1.28: 13.9; miscellaneous, 99.4: 0.88: 13.9 (including 56 million soldiers bonus paid in 21 states); general government, 85.6: 0.76: 8.3; development and conservation of natural resources, 56.4: 0.50: 5.5; protection to persons and property, 55.8: 0.49: 5.4; health and sanitation, 24.8: 0.22: 2.4; recreation, 2.7: 0.2: 0.3. Three of the nine items account for 68.6 per cent of the total. Here is where cuts would have to be made to affect the total materially. From this viewpoint, the first and greatest slash would fall in education, with its 38.4 per cent of the whole outgo; but who that knows the history and spirit of America and the many still unsatisfied demands for school expansion believes that material reduction can be expected in this field? Continued increase is more likely. And so one might go through the list. The greatest hope that can be held with reason is growth in efficiency and economy all down the line, and that will do well if it flattens somewhat the rising curve of state expenses. As to "mounting expenses," it should be remembered that nearly all the figures that give rise to bitter comment take no account of either the lowered purchasing power of the dollar or of making up for expenditures deferred by the war.

Less Hours, More Happiness?

IT IS TOO early to judge whether the American Federation of Labor's pronouncement in favor of a five-day week is a gesture or a policy. Coming as it did right after the Ford Company announced its five-day week program the labor leaders' action received wide publicity, but neither Mr. Ford nor the American Federation can escape some questioning of their motives.

There are signs, for instance, that the saturation point for the Ford car is being approached, what with increasing competition in low-priced cars and the ever rising aspiration of the Ford owner. Possibly all the cars that are needed can be turned out in five days, and for the time being the drop in demand may be met better by having everyone work but five days instead of having five-sixths of the force work six days. Or possibly it is only the latest move of our shrewdest industrialist to insure for himself the cream of the available labor.

The American Federation move, on the other hand, is obviously inside politics. Labor knows that it can hardly build up a national campaign for higher wages; there remains to fight for then only fewer hours. The eight-hour day, for so long a battling point, has been won; the next redoubt to be captured is the five-day week. For the present the campaign need not be taken too seriously but the pennant has been unfurled.

Meanwhile there remain certain truths. General wellbeing is a function of the unit productivity of each consumer. In proportion as each individual can produce more specialized goods at a lower cost does the general consumptive demand of the individual increase. It has been found that to a certain limit this unit production will increase with decrease of man-hours of labor. Instead of the sixteen hours of old we now work eight. But how much lower can we go and still continue to increase or even maintain the economical unit productivity? No one knows, and no one can know until we try. What will happen is a gradual experimentation; a plant here and a plant there will try the scheme out, the bricklayers and the carpenters will become envious of the five-day plasterers and the machinist will demand the privileges of leisure the Wall Street broker enjoys. And then one day it will be found either that the five-day week works, just as the eight-hour day worked, or else it will be found, as it has been in Germany, which has returned to the 9 and 10-hour day, that more labor must be expended to bring the unit productivity back to its economic balance.

We can't keep on indefinitely lowering the hours of labor, but we can recognize that after all there is more theological than economic significance in the much quoted injunction "In the sweat of thy face, shalt thou eat bread." Until that happy time comes when every man has found his work and loves it so that laboring at it brings joy beyond the rewards that his wage can buy, until that time labor will be largely drudgery. To reduce the term of that drudgery is surely laudable, if in so doing there can be assured an individual reward which permits the pursuit of happiness in the additional leisure gained. The catch in the five-day week program of both Mr. Ford and the American Federation of Labor is that so far there is no assurance that we have reached the stage of industrial development when it will work.

Lateral Resistance of Buildings

IN ITS relation to the multi-story city building, the Florida hurricane of Sept. 18 constituted a gigantic emergency service test, the first of its kind in the short history of the skyscraper. The test gave a visible demonstration of the structural action of tall buildings, on which there has been much theorizing and discussion but little proven knowledge. Correspondingly the outcome is bound to affect our constructive practices deeply.

Lateral strength of tier buildings, an apparently simple subject, has always been involved in baffling uncertainties. The engineering problems of design are physically indeterminate, and calculation gives only a crude approximation of stresses and proportions. It is true that practice as developed on the basis of such calculation has found itself justified by experience up to now, but this justification is of doubtful value. Experimental check on design theories, which might make up for the shortcomings of service experience, involves difficulties so great that no successful attempt has yet been made. Hence the quite exceptional importance of the full-size failure test at Miami.

Wall action is the most striking feature of the racking of two tall buildings in Miami. In the one, the Meyer-Kiser building, whose frame suffered a permanent lateral bend, a large area of wall broke out during the distortion. This might be expected; but it would hardly be expected that the other building too should have lost a section of wall, although the steel frame was not distorted, and that other parts of its walls should be cracked and shattered. This unexpected result exemplifies the fact—well known but ignored in design—that framework and walls are a unit with respect to lateral deflection and resistance. It also shows that in this composite unit the weaker component determines the point of first failure; the rigid wall sheared endwise before the steel frame took its stress.

It follows that if we expect our buildings to remain whole we will have to design them in such a way that under maximum wind pressure the ultimate strength of the wall is not exceeded, even though the frame itself could carry a greater pressure. In the somewhat parallel case of bridge floors, slip joints are introduced to cut the floor into independent sections and restrict chord action to the chord itself. This expedient does not seem applicable to building walls; we will probably always have to consider distortion of the walls with the frame as inevitable in tall building structures.

A score of other buildings showed no wall failures, although exposed to the same wind loads as the two which were racked. This appears confusing, but it becomes clearer when we consider that the walls must have contributed a large item of the lateral strength, and in the two extremely narrow buildings this item was relatively smaller than in the others. The failure of the top story of the Meyer-Kiser building tower, which is far from being narrow, is not necessarily in conflict with this explanation, since its walls must have cracked and broken before the frame took more than a small bend, and after this failure the steel alone had to resist the distorting pressure.

Taking all the facts of the interaction of walls and frame, it would seem that in the early stages of the storm-wind attack, the walls of the Realty Board and Meyer-Kiser buildings did the main work of resisting wind distortion; that later the wall masonry sheared or lost bond so that its resistance was destroyed; and that only after such failure of the walls did the framework come into full action. This is quite a different picture of the lateral resisting action of building frames from that on which current designing methods are based.

In this matter of wall resistance and wall failure, it is to be recalled that many modern building codes, including that of Miami, allow a very great departure from the conservative wall construction practice of earlier days, when solid masonry, in thicknesses of 12 in. or more, was required for high buildings. The gradual reduction of wall requirements came about on the basis of the theory that such walls resist side pressure only. Precisely here, it seems, the facts as brought to light at Miami are opposed to theory. Unfortunately for quick harmonizing of this conflict, wall construction is one of the most thoroughly empirical features of tall building construction. Study of the correlation of walls and frames will therefore not prove altogether easy. But at all events the Miami storm lays down the fundamental fact that the wall does function as a resisting web and that we are not at liberty to ignore it.

Equally important new information is given us on floors, and their relation to the integrity of the framework. In neither of the two racked buildings, even in the severely bent and twisted Meyer-Kiser building, is there as much as a crack in floor or ceiling, despite the fact that the floor construction was a very light composite of tile and concrete. The horizontal girder action of the floors, it appears, was adequate to transmit the wind pressure to all parts of the steel frame and inclosing walls. Hitherto structural engineers have recognized this floor action only to a limited degree. But utilizing it fully, every column of the building can be made to share in the wind-resisting action.

Another point in the floor action exhibited at Miami invites attention: In the Meyer-Kiser building the front wall girders remained straight, while the columns bent. This is interesting because the question of the relative bending of girders and columns is at the bottom of the worst complications in the design of office-building frames. Evidently the masonry acted with the girders and made them practically rigid, localizing the bending in the columns. This fact is quite in line with the effective co-operation of floor slab and beam shown in floor bending tests within the past two or three years. It promises to lead to important conclusions on wind-stress analysis of the framework of tall buildings, even to the extent of setting up a new and simpler method of design, with increased efficiency of construction.

Looked at in its entirety, then, the Florida storm experience with tall buildings represents a mechanical analysis of buildings under lateral stress, of such character as to suggest the opportunity for thorough-going revision of building design methods. A gain in simplicity, efficiency and strength of building construction may result; but in order that this may be most fully realized there is need for detailed study of the Miami facts and of the physical facts involved in wind resistance.

It is to be remembered that the large majority of the Miami large buildings suffered no damage, even under more than twice the wind pressure for which they had been designed. Even while looking to further improvement of practice we may feel gratified at this performance.

The Civil Engineer in Industry

—AN EDITORIAL SURVEY—

The First of Four Articles Reporting the Results of a Study Into a Little Appreciated Field of Civil Engineering

I. Plant Engineering

PLANT engineering, for the purposes of this survey, will be considered as the control of the major portion of an industry's operations outside of the processes having to do directly with manufacturing. Two distinctions, moreover, should be emphasized: (1) Plant engineering rarely follows identical organization in dissimilar industries and seldom in like ones. Even in two geographically separated plants serving the same industrial corporation, the plant engineering forces may be quite unlike in organization. (2) For the purposes of this study, the civil engineering functions of the plant engineer are stressed.

From the first of these statements, one correctly concludes that only by describing plant engineering in two or more dissimilar industries can the full scope of the plant engineer's activities be covered. Also, those plants will be described which are of such size that either design or new physical property or its construction, or both, are functions beyond those of the plant engineer. As to the second statement, the explanation can be made that plant engineering comprises such a diversity of civil, mechanical, electrical and non-technical details that any one of these four functional divisions lends itself to extended treatment. It is to try to explain what the civil engineer does in the manufacturing plant or what civil engineering work the plant engineer does that this article is written.

INDUSTRY, that is, the production of finished goods, is enlisting more and more of the engineer's services. The popular view, and the view, too, in engineering circles, is that these engineers are concerned solely with mechanical processes both in the minutiæ of the design and operation of the machine and in the relation that labor bears to the machine. There is, however, a large but unobtrusive personnel in industry whose work and functions have been neglected.

These men are essentially civil engineers in that they have little relation to and no control of the purely mechanical operations of the plant. They are engineers trained in the design, erection and maintenance of structures and in the design and operation of the numerous services the plant requires. Their duties are many and various and are not reducible to a standard, but they are coming to be important factors in industrial works. What they do and how they do it are both outlined in this series, not only as information for these engineers themselves but as information to other engineers who have not realized, perhaps, this widening activity of the profession.

Though in the study undertaken by *Engineering News-Record*, the engineer, and more often than not the civil engineer, has a distinct place of usefulness in factories, whether they be for the making of linen collars or locomotives, it is in the American Telephone & Telegraph Co. and the Baldwin Locomotive Works where examples (though almost extremes) of plant engineering are found which best suit the purposes of this discussion.

Baldwin Locomotive Works

To illustrate the diversity and minutiæ of a plant engineer's responsibilities, the organization at the Baldwin Locomotive Works in Philadelphia is shown herewith in chart form. The plant engineer has supervisory control over all civil, electrical and mechanical maintenance as well as possessing multifarious other responsibilities. However, his actual contact with the specific jobs is small. He does have to have a wide general professional knowledge and a positive aptitude for the expeditious execution of troublesome engineering details. It fact, the position of the plant engineer approximates that held by the practitioner of half a century ago, before the engineering profession became so highly specialized.

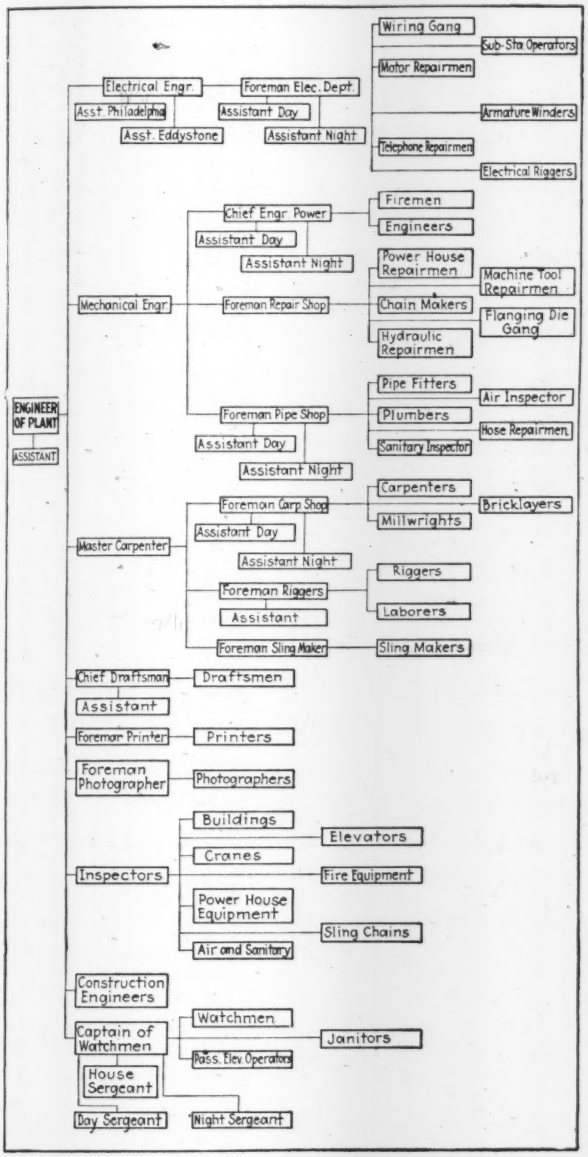
When a representative of *Engineering News-Record* called on the plant engineer at the Baldwin Works, who is a civil engineer and a member of the American Society of Civil Engineers, he was in the midst of the preparation of specifications for control of concrete mixtures on part of the new plant at Eddystone, Pa., near Philadelphia, to which place the entire Philadelphia works ultimately will be moved. But the writing of such specifications was but an incident in his whole work. Power studies might occupy him at the next moment, or the relocation of the 35 posts for watchmen to insure the most adequate policing of the plant when not in operation.

A large force of laborers and mechanics is kept continuously employed in repair work on buildings and equipment. In order to indicate the extent of such maintenance, a few details on the size of the plant are offered. The buildings at the Philadelphia plant, of which there are 55, ranging from one to eight stories in height, cover about 18 acres of ground. Buildings are of brick, brick and steel, and reinforced concrete and have a total floor area of some 50 acres. There are almost 20 acres of roofing, largely slag, though asbestos, corrugated iron and tin are also used. In the various buildings there are about 6 acres of window glass, about 4 per cent of which is replaced yearly. Incidentally, cost of replacement is in the neighborhood of 18 cents per square foot. Painting of buildings requires a yearly expenditure of some $20,000.

Manufacturing machinery includes 155 electric traveling cranes, 9 electric jib cranes, 82 hand traveling cranes, 171 hand jib cranes, 4 hydraulic traveling cranes and 17 hydraulic jib cranes, which equipment needs, for

operation, 438 motors with a total capacity of some 5,662 hp.

As the engineer of plant at the Philadelphia works also has charge, through a local plant engineer, of the Eddystone plant, his duties are multiplied several-fold. The Eddystone plant contains some 73 acres of buildings, the total number being 185, with a floor area of approximately 86 acres.



ENGINEERING ORGANIZATION, BALDWIN LOCOMOTIVE WORKS

Inspection obviously is a major consideration of the plant engineer and his many lieutenants. Brickwork, steelwork, floors and roofs are kept under almost constant inspection. Steelwork is gone over for loose rivets, corrosion, etc., and needed repairs are promptly made. Signs are posted throughout the various buildings indicating the proper floor load per square foot. Inspections for safe loading are made at frequent intervals to see that these instructions are complied with. Most of the buildings are designed for a floor load of 240 lb. per square foot. The greatest floor capacity is 640 lb. per square foot.

Freight elevators are inspected twice a week, passenger elevators daily, and elevator pressure tanks are thoroughly inspected, cleaned and repainted annually. Crane inspection is well nigh continuous, the most important cranes being examined daily. A monthly examination of sling chains in the entire plant is made, a section of the plant being inspected each week.

Fire apparatus, comprising sprinklers, fire tubs and gate posts, and oil lines, power house, air tanks, air lines and sanitary services are other major parts of the plant given almost daily inspection.

Practically all of the new construction as well as repairs and ordinary maintenance is done by forces operating under the plant engineer, who also assists in the design of new structures. Design features and general specifications are mainly drawn up by the consulting engineer, himself a former engineer of plant. The duties of the consulting engineer are so varied, that he directs structural design only in so far as it is affected by the needs of machinery which is to be housed or by manufacturing processes. These considerations are restricted principally to floor loads, ceiling heights, column spacing, and need for light and storage areas.

The engineer of plant, therefore, carries out the construction work designed under the joint supervision of the works consulting engineer and any specialist who may be called in, be he an architect or engineer. Thus, in complete supervision over maintenance and repairs, and in carrying out construction plans initiated outside his department, his duties resemble those of both line and staff officer as found in the regular military establishment.

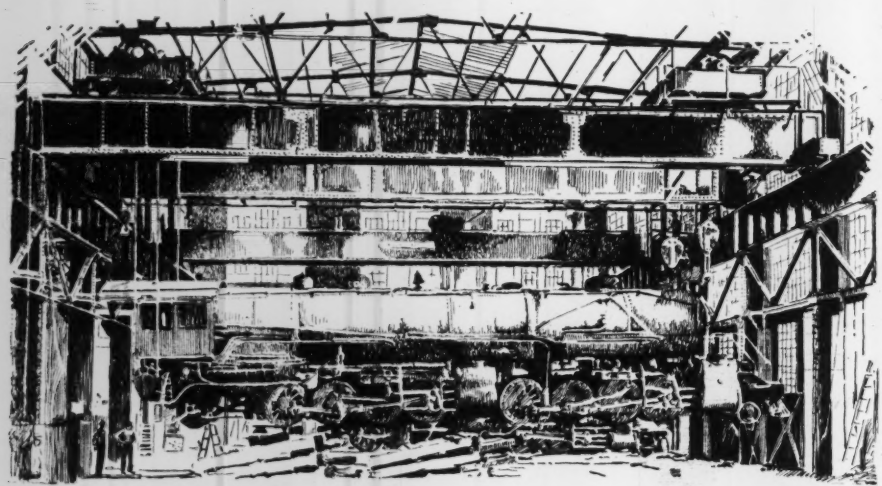
The most elastic of all the sub-organizations in the highway department (which is the local name designating plant engineering) is that concerned with new construction. In the chart shown herewith provision is made for such expansion as building requires through construction engineers reporting directly to the engineer of plant.

In usual maintenance work, building mechanics, particularly carpenters, bricklayers and masons, are found to report to and operate under the master carpenter. This maintenance organization is somewhat changed when extensive new work is undertaken, and the construction engineers are responsible to the engineer of plant for proper execution of the work. The force of construction workers obviously depends for size upon the amount of new work undertaken. At the present time, the force counts many hundreds because of the extensive work being done at the new (and ultimately main) plant at Eddystone.

The carpenters make all forms for concrete work, wooden trestles, scaffolds, etc., for the use of the shop, safety work, and general repairs. During the course of a year about 500,000 ft.b.m. of lumber is used for plant maintenance. Brickwork is under the supervision of the carpentry department, which makes minor repairs to boilers and furnaces. With the carpenters are also included the millwrights. Concreting work, excavation, labor work, etc., are done by riggers and workmen operating in this department. Riggers also move machine tools and any heavy rigging work necessary is done by them.

In the drawing room plans and specifications for some new building and all repairs are executed. The drawing room also designs the machine tools, machine layouts, jigs, and dies for lining up locomotive work. Thus, the drawing room is a combination of all engineering design. Naturally, since new design is often initiated by the consulting engineer's office, and the execution of the plans is supervised by the engineer of plant, there must be close co-operation between these two technical department heads. The fact that the present consulting engineer was formerly engineer of plant gives him unusual sympathy with all the plant engineer's problems, and the two work together constantly.

That part of the highway department which covers organization at the Eddystone plant is practically the same as the organization at the Philadelphia plant. The former, however, contains both tidewater facilities for direct ocean loading and extensive railroad yards,

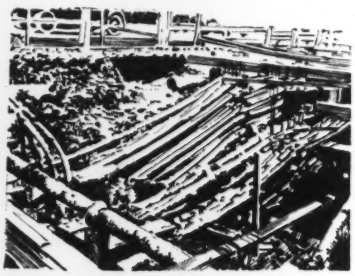


neither of which the Philadelphia plant possesses. At Eddystone special departments are maintained for (1) the care and repair of locomotive shifters and locomotive cranes (of which latter 25 are used about the yards); (2) maintenance of the 25 miles of standard-gage track, and laying of new track; and (3) yard labor. The latter does concrete work principally, though keeping the yard clear of rubbish and cleaning the 21 acres of window glass are other work which they do.

Thus the engineer of plant is the supervisor of practically everything outside the actual manufacture of locomotives and accessories. His must be an exceptionally wide knowledge, and above all his must be a calm and judicious patience.

American Telephone & Telegraph Co.

Though in reality the engineering work done by the American Telephone & Telegraph Co. and associated companies is primarily electrical, there daily arise problems which align themselves with the broader engineering principles. It is obvious that there should be a great deal of civil engineering work, both new construction and maintenance, in connection with furnishing service to 11,000,000 Bell-owned telephone users; particularly when one knows that in furnishing service to these subscribers it has been necessary to erect 6,000 central office buildings, 60,000,000 telephone poles, innumerable suspension cable river crossings, and endless miles of cable and open-wire lines.

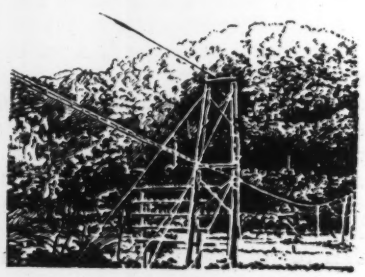


The Bell System includes the American Telephone & Telegraph Co., 25 associated operating telephone companies, the Western Electric Co. (the manufacturing department of the system) and the Bell Telephone Laboratories, Inc.

The engineering department of an operating telephone company is responsible for engineering company buildings and central office equipment, the general design of the aerial and underground lines, and for specifying the standard types of equipment, apparatus, materials, methods used and appliances to be used in the construction and maintenance of the company property. In this connection, the engineering department reviews the plans prepared by engineers of the operating department and co-operates in the preparation of estimates relating to a five-year budget plan of construction and operating results under which each of the Bell System companies operates. In order that the development of the property may proceed in a step-by-step progression along sound, economic lines, fundamental plans are prepared projecting the development program for the growing systems of from fifteen to twenty-five years into the future.

Each associate company has at the head of its plant department a general plant manager who is in entire charge of the plant department activities of that company. Under him are several division plant superintendents and to the latter the division plant engineer reports. There are in the neighborhood of 65 of these division plant engineers in the Bell System and the volume of work for which the forces under their direction initiate plans amounts in money to about $125,000,000 yearly. That work comprises conduits, pole lines, cable and open-wire work.

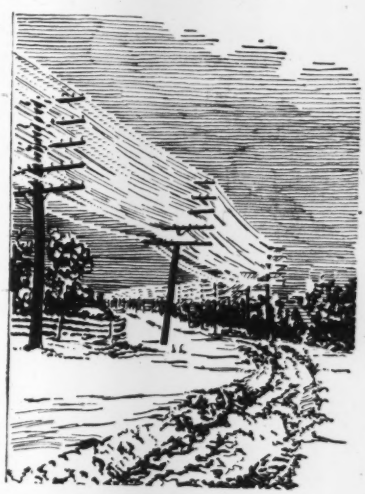
Though the duties of the division plant engineer have to do mostly with electrical engineering, there is under his direct supervision, in co-ordination with the division superintendent of construction, work of a civil engineering and contracting nature. Also, besides being a technical telephone man, the division plant engineer must keep in close touch with all major building operations in his territory. For example, if a large office building is planned, he must get in touch with architects be-



fore the plans are scarcely more than started to arrange for whatever conduits may be required in the floors and elsewhere in order to give the occupants of the building telephone service. He does not know who the new tenants are to be, but through accumulated experience he is given a background for reasonably close estimate as to what the service requirements are going to be.

In addition to these phases of his work, the division plant engineer maintains close relations with other wire-using companies. He must co-ordinate his work with electric light and power men in the territory in order that no opportunity may be lost in getting together with these companies on joint lines or to forestall any adverse effect of power lines on the telephone lines. The position of division plant engineer is generally filled by a technical graduate of high qualifications. The training and experience which these men get in the telephone business in that particular position provide an excellent background for a logical line of promotion.

The construction of the line plant consists in building underground conduits, building pole lines, placing underground cable, and placing block cable, house cable, cable on pole lines, and all of the cable splicing work. Generally speaking, the construction department objective is to obtain economy of cost and efficiency of results. The standards and material and the technical methods are prescribed by the engineers and laid down as standard practice. One of the principal means through which economy and efficient results are obtained is controlled by the superintendent of construction in scheduling work so as to correlate labor and material supplies.



The pole lines are probably the most familiar units of the outside telephone plant. The design of a pole line and the selection of the proper size of pole present an interesting problem in cantilever beams often complicated by the determination of the load to be carried during the expected life of the poles. This will depend upon the number of wires or cables to be strung and the deposit of snow or sleet, together with the wind which may accompany or follow it, against which it is practicable and economical to build the line. The telephone pole lines and underground conduits with open wires and cables must be constructed in remote territories as well as populous areas, and all sorts of local and climatic conditions are encountered in connection with the work. The handling of this widespread construction program is made possible by a transportation service, consisting of about 11,000 Bell System motor vehicles capable of moving gangs of men and all sorts of materials under widely varying conditions.

Properly organized and conveniently located forces handle the work by first ordering proper quantities and types of materials in accordance with plans supplied by the plant engineers. Construction gangs are assigned to various parts of the work in accordance with a general plan. The labor-saving devices which have been developed for this work include derricks for handling poles, pole-hole diggers, numerous applications of compressed-air machinery which is especially useful in opening street pavements, trailers for delivering poles and cable reels, etc. Many of these devices have been designed to form integral parts of the transportation units. The setting of a single telephone pole may seem a simple matter, but when it is known that the telephone companies erect about 600,000 new poles each year, and move, reset or straighten large numbers of the 60,000,000 poles in the existing plant, the importance of devising means for reducing, in so far as is practicable, the relatively high cost of manual methods of handling these poles may be realized.

In the construction of central office buildings, of which there are upward of 6,000 throughout the country, it is necessary to take account of local demands for type and locality of station. Though the exact location of a central office is dependent more or less upon the density of telephone subscribers, local considerations are given a thought, and close touch is kept with planning and zoning commissions in practically all the cities in the United States. Inasmuch as the central office plant is of such a character that practically the only type building which can be erected is a square box, exterior architectural features are relied upon to harmonize the building with its surroundings. Actual construction of central office stations is done under contract and the design is almost invariably supplied by a local architect. However, the plant engineer confers with the designer as to size and type and shape of structure necessary to house not only immediately needed telephone plant, but that which will care for an expected reasonable service growth.

Other Plants: Conclusions—In these two foregoing plant descriptions are found about the extremes of plant engineering in the establishments surveyed by *Engineering News-Record*. In between are innumerable smaller industries whose plant engineers are largely mechanical superintendents. However, in each one of them there have been found maintenance and repair problems of a strictly civil engineering nature. Sometimes, for instance in a certain sugar refinery investigated, an electrical engineer had been placed in charge of all engineering which includes considerable dock and railroad yard repair work—distinctly civil engineering work. In one of the larger coffee-roasting plants in the country, all civil engineering work was divided from the mechanical department (which department not only maintained the equipment but designed special machines), was supervised by a man who really was a master building mechanic. His duties, however, were limited to some dock work, building repair and railroad yard maintenance.

In conclusion, the plant engineer must possess the broadest general technical knowledge. His constant association either with manufacturing executives or the lay public, or both, makes the possession of business personality a necessity. Finally, in some industries he possesses a tremendous buying power, for either directly or indirectly he has control over the purchase of every known kind of mechanical, electrical and construction equipment and materials—purchases that involve hundreds of millions of dollars yearly.

Two Arch Dams Fail Through Undermining of Abutments

Thin Concrete Arch Dams Lose Abutments by Erosion of Soft Rock—Neither Concrete Structure Fails When One End Is Left Unsupported

TWO very similar thin concrete arch dams within the past eighteen months have failed through the destruction of one abutment. One dam was that of the Cynide Gold Mining Co. on the Moyie River, near Bonners Ferry, Idaho, and the other was that of the Lake Lanier Development Co., Tryon, N. C. In both cases the abutments were founded upon soft rock. In the first case, a very unusual flood overtopped the dam and washed out the soft rock against which it abutted by first undermining and washing out the spillway channel which was put in to protect the rock. In the second case, failure occurred through simple undermining of the cyclopean masonry abutment which had been built at the end of the dam to replace unsound rock.

It is interesting to note that in both cases the thin concrete arch dam itself stood up under the pressure of a body of water which reached nearly up to, and in one case probably above, the crest of the dam, even after one abutment had been destroyed. Detail descriptions of the two failures are given below.

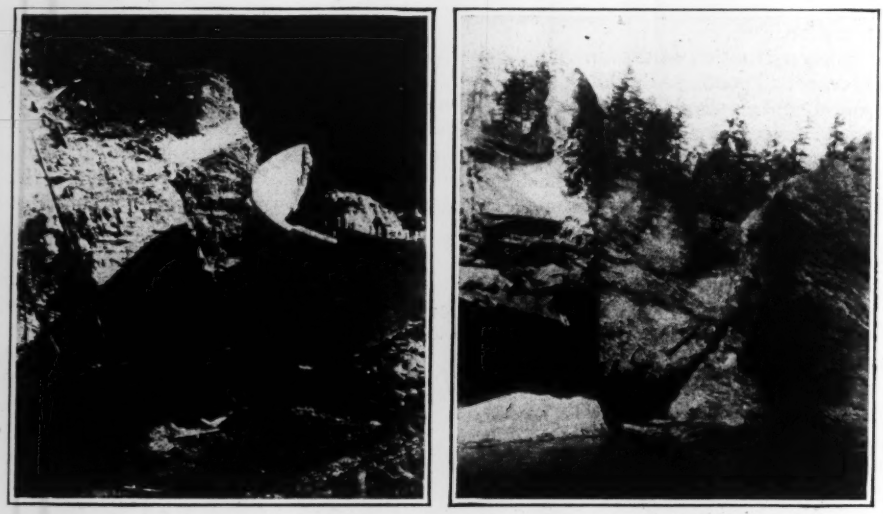


FIG. 1—MOYIE DAM AFTER LEFT ABUTMENT WAS CARRIED AWAY

White band on the rock at the left of break in the left hand picture is the side wall of the spillway destroyed by the flood. The extreme end of the arch is seen suspended in air over the place where the abutment rock was carried away.

Moyie River Dam, Idaho

A HEAVY rainstorm, described as a cloudburst, occurred last year near Bonners Ferry, Idaho, and a flood of unprecedented volume swept down on the concrete arch dam of the Cynide Gold Mining Co. on Moyie River. One report states that the flood was in part due to the failure of three small dams in British Columbia. The spillway of the Moyie dam, a timber-lined canal in a saddle passing around and close to the left abutment, was undermined and carried out, after which the flood waters cut a deep bypass around the dam through this saddle and carried away the upper part of the abutment, leaving this end of the dam partly unsupported.

The dam has a height of 53 ft. of which the first 6 ft. in the river bottom consists of a concrete base poured in a cutoff trench. At the top of this base the arch section has a thickness of 64 in. which decreases to 24 in. at the crest of the dam. The upstream face is vertical. The dam is curved on the arc of a circle with a 65-ft. radius; the crest length is 154 ft. The concrete mix used was $1\frac{1}{4}:2\frac{1}{4}:4\frac{1}{4}$ and reinforcing consisting of 20-lb. railroad rails on 2-ft. centers, both horizontally and vertically, was placed 6 in. back from the upstream face.

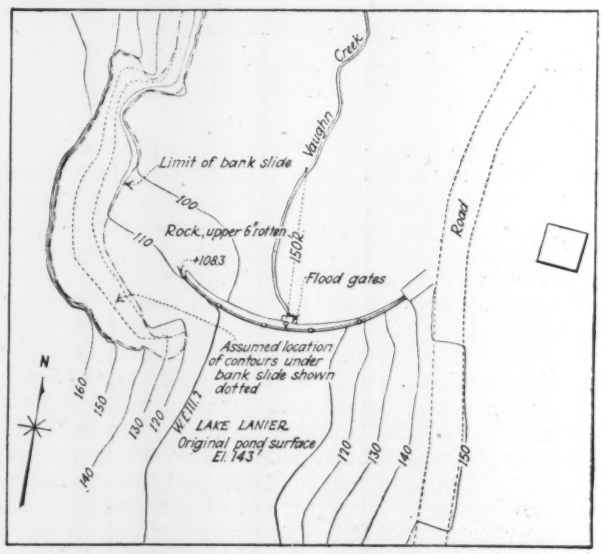


FIG. 2—LAKE LANIER DAM SITE, AFTER WASHOUT

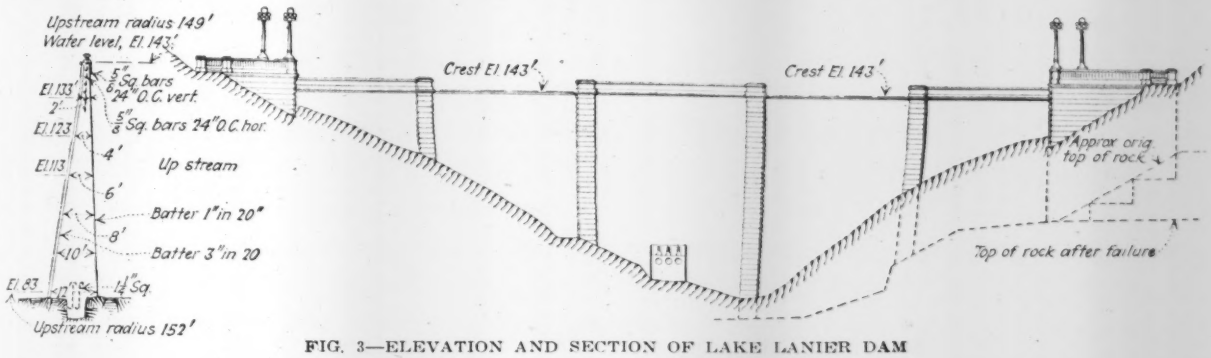


FIG. 3—ELEVATION AND SECTION OF LAKE LANIER DAM

The point selected for the left abutment was a narrow ridge or neck of rock which at this point separates the main river channel from a small tributary in a narrow canyon that joins the Moyie a short distance downstream. The spillway emptied into this adjacent canyon, utilizing the saddle or low point in the ridge as a convenient location for an overflow channel from the reservoir. The narrowness of this ridge is indicated by the fact that before the flood the spillway, 24 ft. wide, 12 ft. deep, was only 50 ft. long.

The rock forming this ridge is stratified, and the layers slope downward in an upstream direction at an angle of about 30 deg. Some of the strata are reported to be softer than others and it is suggested that backwater in the small tributary at the time of the flood washed out the softer strata, leaving the others without support so that the whole rock structure was weakened at the time of greatest stress.

No definite information is available as to the actual size of the flood. Estimates as to the depth of the water flowing over the dam range from 7 to 15 ft. After the break in the spillway occurred the force of the water flowing out through this gap cut a notch to a depth of about 50 ft. below the crest of the dam. This notch through the saddle originally occupied by the spillway is 18 ft. wide at the bottom and 80 ft. long.

It is reported that the dam is to be repaired by the construction of a concrete pier where the left abutment was washed out. The dam was originally designed by Otto Jones of Spokane. For the foregoing information *Engineering News-Record* is indebted to J. Harley Cave, county surveyor, Boundary County, Idaho.

FIG. 5—LOOKING UPSTREAM, ABUTMENT OF LAKE LANIER DAM

Lake Lanier Dam, Tryon, N. C.

A CONCRETE arch dam forming an artificial body of water known as Lake Lanier at Tryon, N. C., failed on Jan. 21, 1926, through the washing out of one abutment. A report of the failure was given in our issue of Jan. 28, 1926, p. 172. The dam itself stood even after the abutment overturned and as it was uninjured a new abutment is being built.

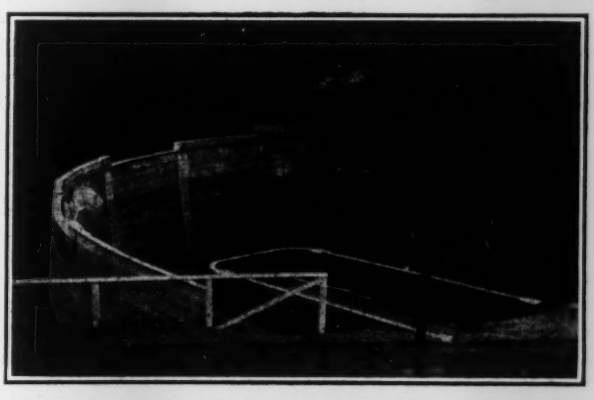


FIG. 4—LAKE LANIER DAM BEFORE THE FAILURE
Looking toward the west bank showing the abutment which washed out.

The dam is concrete arched on a radius of approximately 150 ft. It is 236 ft. long between abutments, 62 ft. high at the highest point from bed rock to top of spillway, with a 5-ft. cutoff wall. It is not reinforced except in the upper 12 ft. and by anchors into the cutoff trench. A section and elevation are given in Fig. 3. The dam is founded upon rock throughout its entire length.

As the drainage area above the dam is small, the only provision for the discharge of flood water was by overflow of the two immediate of a total of five panels.

FIG. 6—LOOKING DOWNSTREAM FROM LAKE LANIER WASHOUT
Decomposed and shattered condition of rock in bank shown in exposed face.

Preliminary investigations of the site indicated that sound rock would be found in the banks for the abutments, but as the work progressed the upper rock was found to be soft and the abutments were made of a mass of cyclopean masonry faced with an ornamental concrete wall, with cutoff wall on upstream side, carried to from 4 to 6 ft. below base of the abutment on the west side. The dam was completed in March, 1925, but due to a drought the reservoir never filled with water until two days previous to the time of failure. According to statements of local residents, ice began to form along the banks on both sides of the valley below the dam as water rose behind the dam. On Jan. 19 water began to flow over the spillway. On the morning of the 21st a considerable flow of water was seen to issue below the west abutment. This flow increased rapidly. It was followed by settlement of the abutment, and, in a short time, by its overturning. The rush of water around the end of the dam rapidly cut into the west bank which was of earth, decomposed rock between layers of harder rock, and some clay. The plan in Fig. 2 shows the condition of the site after the washout of the abutment.

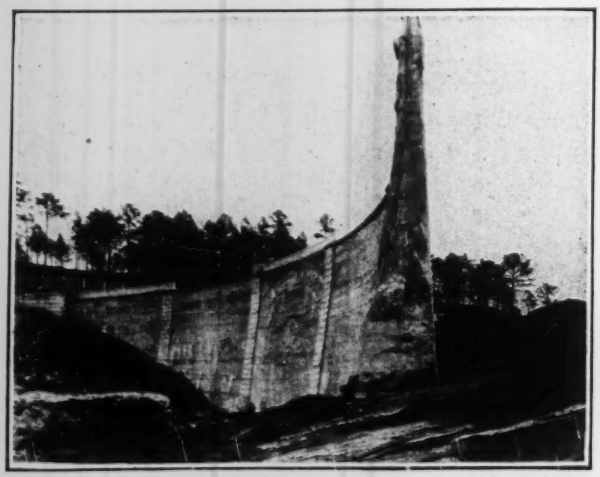


FIG. 7—REMAINING PORTION OF LAKE LANIER DAM
The end of the arch dam in the foreground was the construction joint between the arch dam and the abutment.

Cause of Failure—Failure appears to have been due to the presence of decomposed rock under the west abutment and below the cutoff wall under that abutment.

The dam was built by the Tryon Development Co., Tryon, N. C., from plans prepared by George Kershaw, consulting engineer, of Hendersonville, N. C.

Parking: A Preventable Evil

Extracts from paper entitled "The High Cost of Congested Streets," by Col. C. O. Sherrill, city manager, Cincinnati, Ohio, at the annual meeting of the American Electric Railway Association, Cleveland, Ohio, Oct. 5, 1926.

THE PARKING evil is the crux of the traffic situation. On every street where traffic is dense, lines of parked cars can be seen along each curb. The available space for traffic on these streets is therefore reduced by two full traffic lanes, which is usually from one-third to one-half of the street's capacity. There is only one real and absolute solution of the problem of traffic congestion, and that is the enforcement of necessary laws forbidding the parking of private motor cars in congested areas. This would at once make all streets fully effective, except where interference would occur due to loading and unloading of trucks, which could be so regulated as to have this work done during the hours when traffic is not dense. Not only would this law automatically release two full lanes of traffic in each street, but indirectly it would be of equally great importance in discouraging the movement into the restricted areas of large numbers of motor cars now driven in and parked there unnecessarily. In some cases during periods of greatest density of traffic it may even be necessary to forbid stopping of cars as well as parking, because a momentarily stopped car at intervals along each square destroys the lane of traffic adjacent to the curb.

Certain motor car owners are a specially privileged class to be allowed to occupy so large a percentage of the street area with such a very small percentage of the motor cars. In Cincinnati the congested district has been estimated to provide parking space at the curbs for approximately 3,000 motor cars. There are registered in the city approximately 100,000 motor cars, and in the metropolitan area directly tributary there are not less than 150,000. Parking privilege, therefore, is granted to from two to three per cent of the car owners at the expense of the rest of the 97 or 98 per cent; or some 5,000 persons are given this privilege at the expense of some 400,000 residents who suffer from traffic congestion.

All studies by traffic experts now point to the same conclusion, namely, that the only solution of the problem of traffic congestion is the complete prohibition of parking within the congested district. Only about 8 per cent of the shoppers going to the downtown district of Chicago use their own motor cars. A similar survey in Cleveland recently showed that 65 per cent of the shoppers travel on street cars, about 10 per cent on motor buses, 20 per cent in private motor cars, and five per cent on foot. Two years ago a similar survey showed that 46 per cent came in motor cars, as compared with 20 per cent at the present time.

Land value in the heart of large American cities ranges from $10 to $100 per square foot. At a low average of say $30 per square foot, a parked car takes up about $3,000 worth of space. Each of the thousands of parked cars in the congested area of Cleveland is costing the citizens as a whole say $150 a year to give a few hundred citizens preferential treatment.

Retail merchants and other commercial interests were formerly a unit in opposing restricted parking, but they are now fortunately beginning to realize that this parking benefits such a small number of individual shoppers as to be negligible in furnishing business to the stores. I feel sure that the time is approaching when parking will be entirely eliminated from the congested area of our principal cities on request of the retail merchants themselves. Owners of cars will leave them at home and ride in street cars and buses or will drive their cars to a convenient parking place outside of the congested district and from there walk, take a taxi, bus or street car to their place of business.

Concrete Arch Bridges Support Clarifier Mechanism

Adopted for Esthetic Reasons in Place of Usual Steel Bridges for New Plant at Springfield, Illinois

By Lorenz G. Straub
Structural Engineer, Burns & McDonnell Engineering Co.

ARCH structures for supporting the clarifier equipment represent an innovation that adds much to the appearance of the new water softening and iron removal plant for Springfield, Ill. The usual support for mechanical equipment in clarifier installations has been the parallel chord truss bridge of the Pratt type. Generally a wood house has been built in the center of the bridge to shelter the driving equipment and lifting mechanism. Esthetic treatment was given much consideration in the design of the entire plant since all of the structures can be seen from a distance of a half mile or more when one approaches the site on the main road. The buildings are of brick trimmed with cut stone and rest upon reinforced concrete substructures. The basins are of concrete having all exposed surfaces rubbed to a smooth uniform appearance. A desire to hold the same general architectural effect in the entire plant resulted in the choice of concrete structures to support the clarifier mechanism. Concrete girders were considered but proved to be unsatisfactory because they would have had to be very large on account of the long span and heavy load concentrated at mid-span, and because a girder bridge would present some difficulty in the installation of the standard clarifier lifting mechanism.

The installation at Springfield includes two clarifiers 63 ft. square and 15 ft. deep. The rainbow type of through-arch bridge was chosen to span the clarifier basins for it is an inherently beautiful structure and allows for a suitable house over the mechanical equipment. The bridges each have a span of 65 ft. 4 in. c. to c. of bearings, and a 13-ft. 3-in. rise, with the trusses on 8-ft. centers. The floor is supported by hangers extending from the arch ribs. A 1:2:4 mix of concrete was used.

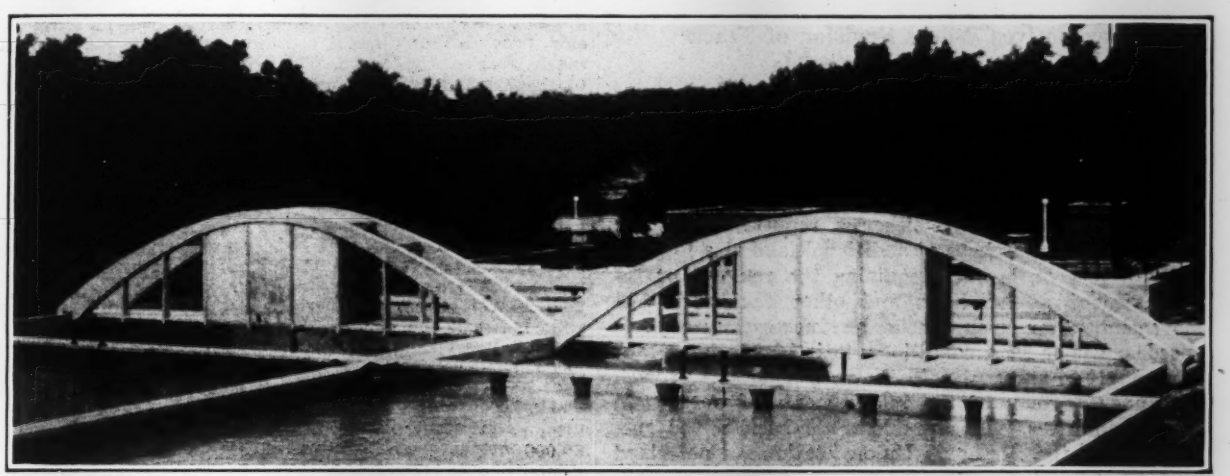


FIG. 1—CONCRETE BRIDGES SUPPORTING OPERATING MACHINERY FOR SPRINGFIELD, ILL., CLARIFIERS

Horizontal thrust from the arches is taken by tie-rods embedded in the floor under each arch. The tierods are continuous from springing to springing. Each rod is anchored at both ends by a hook bent on the end of the rod. The hook is surrounded by a spiral of ¼-in. steel rod to prevent splitting the arch rib. The vertical load is carried on the walls of the clarifier basins. Expansion is allowed at one end of each bridge by providing a segmental expansion-roller surrounded by a mastic in the wall under each arch.

It was desirable to make the dead-load of the structure as small as practicable, especially at the center of the bridge where heavy machinery is supported. Thus, the housing was made of metal lath and stucco. Even with these precautions the concentrated load of the machinery at mid-span and the comparatively light load

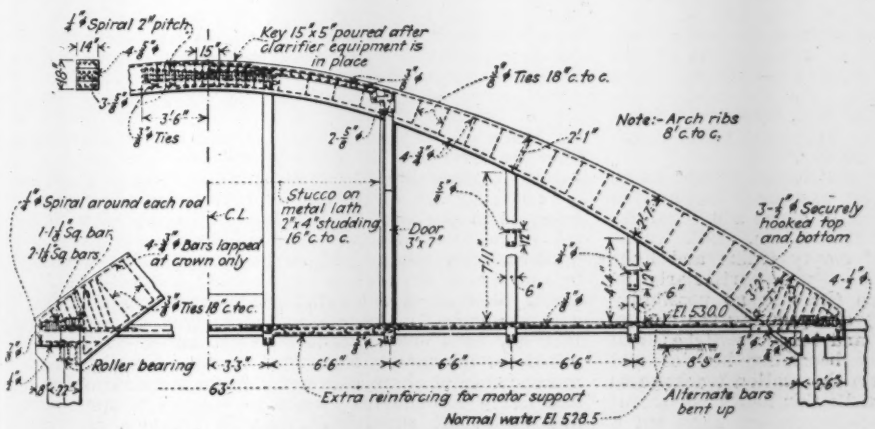

Spiral 2" pitch
Key 15"x5" poured after clarifier equipment is in place
Ties 18" c. to c.
Note:- Arch ribs 8' c. to c.
Ties
Spiral around each rod
C.L.
Stucco on metal lath 2"x4" studding 16" c. to c.
Door 3'x7"
Bars lapped at crown only
Ties 18" c. to c.
3-¾" ø Securely hooked top and bottom
El 530.0
Roller bearing
63'
Extra reinforcing for motor support
Normal water El. 528.5
Alternate bars bent up

FIG. 2—DETAILS OF CONCRETE ARCH BRIDGE FOR CLARIFIER MECHANISM SUPPORT

along the remainder of the bridge resulted in a line of thrust in the arch that is nearly triangular in shape and somewhat rounded at the crown. Hence in order to provide a graceful curve to the rib the haunches had to be designed to withstand large flexural stresses as well as the direct thrust.

A temporary hinge connection was provided at the top of the arch ribs and filled after all heavy machinery had been placed. The hinge was formed by making the depth of the arch 8 in. for a distance of 1 ft. 3 in. at the crown. This portion of the rib was reinforced with longitudinal steel and spiral hooping.

Design and construction of the Springfield water purification plant were under the direction of Burns & McDonnell Engineering Co., Kansas City. Cope & Fisher of Decatur, Ill., were the general contractors.

Terminal Track Layout as Related to Engine Wheelbase

Experience in Maintenance Under New Long Locomotives Where Revision of Track Layout Is Impracticable

TRACK layouts of terminal systems in many large cities were developed before the introduction of heavy locomotives with long wheelbase and are characterized by short turnouts and very sharp curves. To reduce the curvature and lengthen the turnouts would involve, in many cases, either a reduction in track capacity or the purchase of additional land at a high or prohibitive cost, besides requiring the removal or rearrangement of buildings and other facilities. All movements over such tracks are necessarily at low speeds. Under such conditions, it is highly important to strengthen and maintain the present tracks in such a manner as to meet the requirements of heavy and long locomotives. This problem has been solved successfully at the St. Louis Union Station, as described by H. J. Pfeiffer, chief engineer of the Terminal Railroad Association of St. Louis, in a paper read at the annual meeting of the Roadmasters and Maintenance-of-Way Association held at Chicago in September. An abstract of the paper, giving methods and results, follows:

At the St. Louis union station there are 32 station tracks running northward and approximately at right angles to the main lines, with which they are connected by two three-track throats forming a Y, thus allowing six simultaneous moves into or out of the station. The complexity of the track layout is illustrated by the fact that it contains 74 single turnouts, 51 slip switches, and 21 track crossings. With the limited distance from the main lines, to the ends of the station tracks it is imperative to use the shortest possible curvature to secure tracks of maximum length to hold present-day trains. For the main leads into the station the curvature is 16 deg., with No. 7 frogs for the slip switches and turnouts. There are a few cross-over tracks with a curvature of 20 deg.

These tracks are used without restriction, except as to speed, by the heaviest and longest passenger locomotives of eighteen railroads in hauling daily about 260 regularly scheduled trains into and out of the station. This traffic, with the necessary switching of empty trains and light engines, keeps the station tracks busy, particularly at certain hours of the day. Since there is no possibility (short of complete abandonment) of equipping the station track layout with easier curves and longer switches, and since locomotives are constantly becoming heavier and longer, it is necessary to maintain the station trackage to a very high standard, so as to handle this heavy movement with expedition and safety. Derailments are rare, but a study of them develops the following points: (1) Locomotives derail much more frequently than cars; (2) in almost every case the derailment is at a frog, guard rail or track crossing or while moving around a curve; (3) few derailments occur at switch points, or on curved tracks, where there are no frogs and guard rails; (4) derailment on an unbroken straight track is almost unknown. As a result of the close attention given to maintenance of the station trackage, and the application of devices to correct defects exposed by this study, derailments have almost ceased.

A first requisite for good safe maintenance, particularly in switches and on curves, is a track that will maintain its alinement surface and gage under traffic. This can only be secured with heavy track on a substantial roadbed. The St. Louis station tracks, well drained and rock-ballasted, having 100-lb. rails laid on sound ties with ¾-in. tie-plates 8 in. wide, are being maintained to true alinement, surface and gage at moderate labor cost.

As the speed is limited to a maximum of 20 m.p.h. all tracks, regardless of the curvature, are laid without superelevation. The wear of a curved track invariably depresses the inside rail; therefore, a track laid level to begin with can go longer without attention than one that has had superelevation built into it. A gage of 4 ft. 8½ in. is standard, regardless of the rate of curvature, and is being successfully maintained. Detailed examination shows that the head of a rail that has been laid for some time on the inside of a curve, regardless of the rate of curvature or gage of track, becomes flattened and flows over on the gage side, proving that there is not the least flange wear on the inside rail of the curve. This indicates, and our actual experience has proved, that widening of gage on curves is unnecessary and adds to maintenance cost, because all curved track becomes widened by wear, so that, if you begin with a widened gage, earlier re-gaging becomes necessary. To reduce friction, the daily oiling of the gage side of the outer rail on curves, of switch points, guard rails and frogs has been practiced for about three years.

Derailments—Since practically all derailments occur in turnouts and crossings, the improvement of these parts has been studied carefully. Much difficulty has been experienced in keeping crossing frogs and turnout frogs in position, particularly on curves, there being a decided tendency to slide between the spikes. In fact, on some sharp curves it was almost impossible to hold the frog in position. It has been developed that a guard rail, particularly a long guard rail opposite the guard on a frog and on a curved track, because of the narrow flangeway on each side of the track, restricts the movement of driving wheels held together in the frame of the locomotive to such an extent that without lateral movement of the entire track and alternate slipping in and out of the rail between the spikes a derailment can hardly be avoided.

About five years ago some of the lines entering the St. Louis union station introduced a very long and heavy type of 4-8-2 locomotive, which at first caused so much trouble while moving through switches on sharp curves that it was necessary to restrict them to the tracks with easier curvature. Very careful tests and studies of these locomotives and the tracks showed that the derailment invariably occurred in a back-up movement and that the back driver mounted the guard rail about two feet ahead of the frog point on a sharp curve. It was thought that this might be due to the cramping of the locomotive driving wheels between the guard rail and the guard on the frog. As an experiment, a few self-guarded frogs were installed and the guard rails were removed. In these frogs the wheels are guided by raised flanges which engage the outside of the rim of the wheel (see *Engineering News-Record*, June 26, 1924, p. 1093). It was found immediately that the movement of these locomotives was much freer with no further difficulty in keeping the frogs in position.

Practically the entire station layout, including crossing frogs up to angles of 28 deg., has been equipped with solid cast manganese-steel self-guarded frogs, and these locomotives, with others just as long and heavy, now move in and out of the station unrestricted and without derailment. Because of this satisfactory experience as to safety and economical maintenance, the flanged or self-guarded frog has been made standard on the entire St. Louis terminal for all except high-speed tracks. Finally, the safe maintenance of sharp curves and short turnouts under long and heavy locomotives cannot be secured without careful and competent supervision, capable foremen and expert trackmen, to discover and correct irregularities before they become so bad as to cause trouble.

Novel Methods Used in Building Long Concrete Arch Bridge

Pier Foundation Cylinders Sunk from Overhead Suspension—Raising and Releasing Steel Arch Centers for 304-Ft. Spans of Fort Snelling-Mendota Bridge

By William H. DeButts
Resident Engineer, Koss Construction Co., Des Moines, Iowa

IN CONSTRUCTING the long concrete arch highway bridge across the valley of the Minnesota River between Fort Snelling and Mendota, Minn., several interesting features were developed. This bridge, now nearing completion, consists of thirteen open-spandrel two-rib arches 304 ft. c. to c., with a short slab approach, making a total length of 4,119 ft. Its roadway is 120 ft. above water. The foundations extend

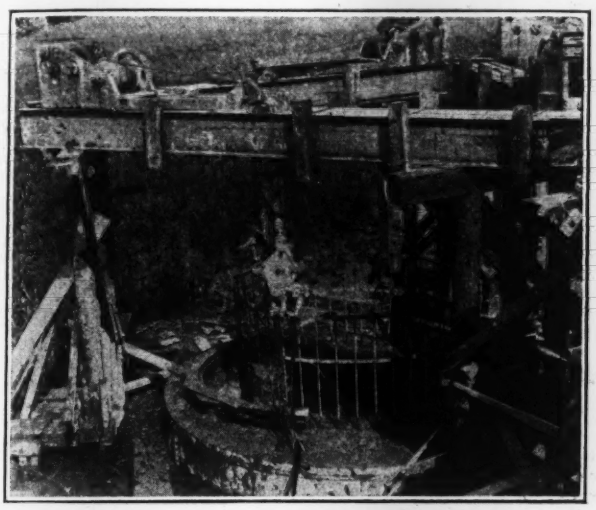


FIG. 1—CYLINDER FOR FORT SNELLING BRIDGE PIER FOUNDATION SUSPENDED WHILE SINKING

to solid rock at an average depth of about 80 ft. below ground level.

Foundation Piers—Each of the twelve main piers consists of four concrete cylinders connected by heavy reinforced-concrete walls above the ground. All of these cylinders were sunk by the open dredge method, additional sections of the concrete barrel being built as sinking progressed, so as to keep the top of the concrete above ground. The bottom section of each cylinder, 22 ft. in diameter and 11 ft. high, was reinforced by a structural steel frame, to the outer edge of which a steel cutting edge was attached. Above this bottom section or footing, the cylinders were of 14-ft. outside and 10-ft. inside diameter, having a 2-ft. wall reinforced with heavy vertical bars held in place by circular bar bands attached to them by U-bolts at every intersection.

No particular difficulty was encountered in sinking the cylinders, except that great care was necessary to keep them in exact position until the cutting edges were on bedrock. Then the cleaning of the rock surface was a problem, as the soil was such that the cylinders could not be unwatered without a "blow in" under the cutting edge, which would fill the bottom with sand and silt. The method adopted was to use a pipe jet, operated from the top, to wash the loose material from the edges to the center of the excavation, where it could be removed with a clamshell bucket. After this washing process, each cylinder was inspected by a diver before it was sealed, a seal coat 8 ft. thick being placed under water with bottom-dump buckets. After this concrete seal had set, the cylinder was pumped out and filled with concrete.

At one pier the footing cylinders were placed in about 14 ft. of water, and two other piers were located on swampy ground where the soil did not have sufficient bearing value to support the weight of the concrete as it was poured. Each of the twelve cylinders of these three piers was supported by means of three heavy blocks and falls hung from a triangular frame of

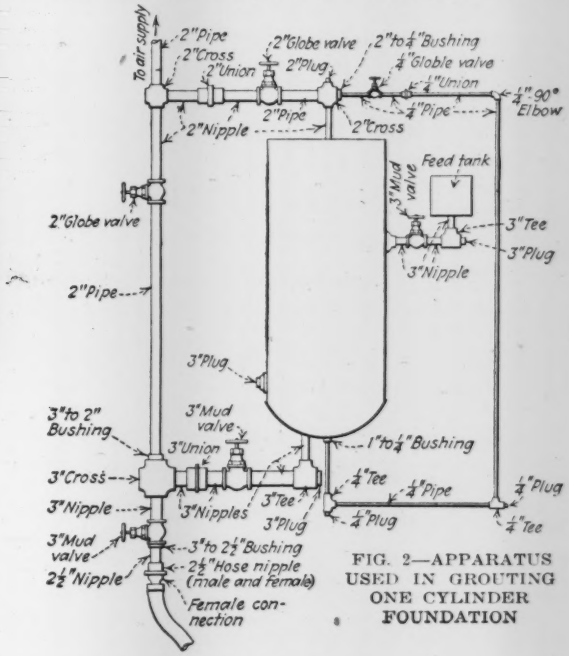
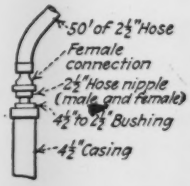


FIG. 2—APPARATUS USED IN GROUTING ONE CYLINDER FOUNDATION



I-beams which rested on pile bents, as shown in Fig. 1. Sufficient tackle was provided to support all four cylinders of one pier at one time. Heavy cable slings were attached to the steel frame of the cutting shoe and the lower blocks were fastened to these slings with a specially designed releasing shackle, which could be released under water when the bearing value of the soil became sufficient to support the weight. This method of handling in soft ground proved very satis-

factory and the supporting cables had the added advantage of helping materially in controlling the position of the cylinder during sinking.

With one exception the bedrock under the footings was level. Under this one footing a fault in the bedrock caused a slope of about 6 ft. in the rock surface in the 22-ft. diameter of the cylinder shoe, although the rock was level under the other three cylinders of the pier. When the cutting edge rested on the highest part of the rock, the excavation was stopped, while the clean coarse sand and gravel overlying the rock was grouted with a mixture of cement and water forced by air pressure through pipes driven to the rock. The pipes were gradually withdrawn as the grouting proceeded. This apparatus is shown in Fig. 2. After allowing time for this cement to set, test holes showed a good impregnation of the cement and proved that the grouting had been successful.

Handling Arch Centers—The great height of the concrete arches and the extremely small bearing value of the soil combined to make it more economical to use steel instead of wood for arch centers. These steel centers, Fig. 5, have also proved their advantages in speed and economy. They are three-hinged arches supported at the ends on cast-steel shoes set on the concrete pier caps.

An unusual method employed for handling the steel centers is illustrated in Figs. 4 and 5. Each half-span of centering is erected in a horizontal position at the level of the spring line of the concrete arch, with the pier end resting on the cast steel shoe mentioned above. Wooden bents 60 ft. high are erected over the pier skewbacks. Back stays or guys run from the tops of these bents to an anchorage around the cylinders of the next pier. The fore lines are attached to the steel centers near the tip and lead through a 9-part tackle to the top of the bent. The free end of the line is carried down to a special winch mounted on the side of the pier. Eight of these winches, each operated by an electric motor, are required to lift a single span of centers. Both the backstay and foreline cables are hitched up in pairs around equalizer sheaves, so as to distribute and equalize the loads on the different lines.

After the two halves of the steel arch have been lifted to the required height, the center pins are placed in position and the winches are slacked off until the load is carried on the pins. A complete set of centers for one arch weighs about 400 tons. Each half requires four 2½-in. galvanized bridge cables for backstays. The tackle on each of the four forelines for each half span of centers is reaved up with nine parts of ¾-in. cable. Each of the wooden bents has four 60-ft. posts 16x16 in.,

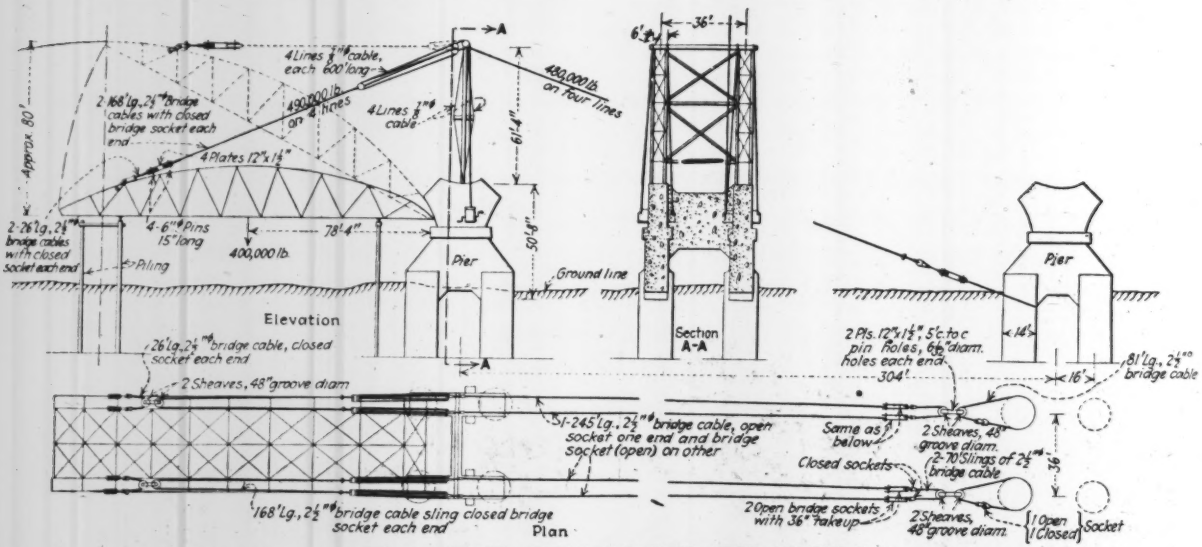


FIG. 3—WEDGES FOR RELEASING ARCH CENTERS

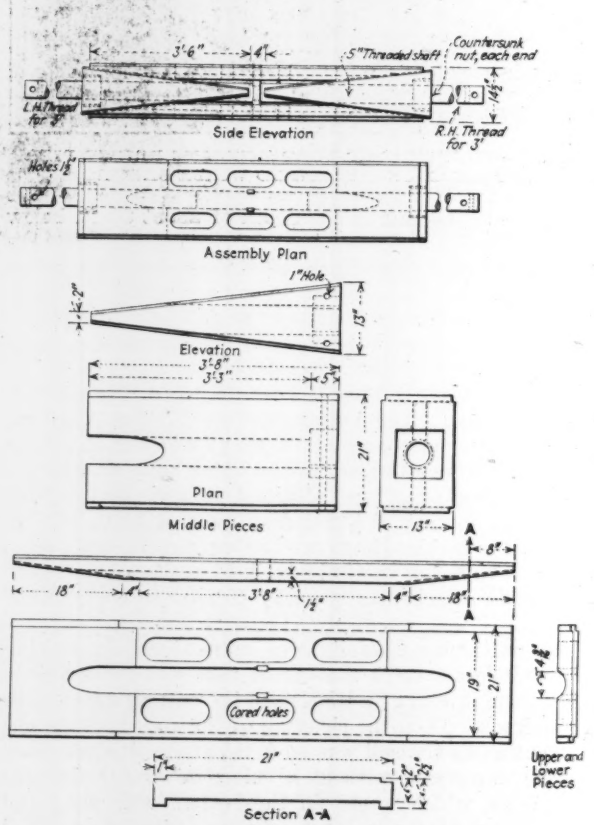


FIG. 4—LAYOUT OF TACKLE FOR HANDLING ARCH CENTERS

capped with another 16x16-in. timber. These bents are heavily swaybraced, which stiffens the column in one direction, while truss cables support them in the opposite direction.

The bottoms of the wooden columns were cut semi-circular and shod with steel plates, which rest in cast-iron shoes of the same shape, anchored to the top of the concrete pier. Besides decreasing the bending moment in the posts under unequal loads, the semi-circular ends facilitate the connection of the backstay cables, because the bent is leaned back to give enough slack to make the backstay connection, after which the foreline is tightened with the winches to bring the bent back into an upright position.

With the centers in place, forms are placed for the arch rib, the reinforcing is placed and the concrete poured. The centers are removed in from 30 to 45 days, depending on the weather. Double-end steel wedges, Fig. 3, are used to release the weight of the concrete from the centers. Cast-iron shoes which are pin-connected to the pier ends of the arch centers rest on the double-end steel wedges, supported on cast-steel shoes on the pier caps, which were heavily reinforced for this purpose. Each of the wedges consists of a cast-steel cap plate and a base plate between which are placed two steel wedges with the points facing each other.

Through the center of the wedges there is a 5½-in. bar, threaded on both ends, one end with right-hand and the other end with left-hand threads. This threaded rod has holes in each end for capstan bars by means of which it can be turned, so that the wedges are forced apart and the cap plate is lowered. Each side of the tapered wedges has a slope of 1 on 8, so that a horizontal movement of 4 in. will lower the wedge 1 in. As a total of 16 in. of horizontal travel is provided, it is possible to lower the wedge 4 in., which is enough to take care of the deflection in the steel centers and provide sufficient clearance for the release of the center pin.

Eight heavy hand winches with special brakes are mounted over the center of the concrete ribs for lowering the centers. The ⅞-in. cables from these winches lead through a four-part tackle, the upper blocks of which are attached in pairs to either end of a 2½-in. equalizer cable, supported on a saddle over the center of the rib. The lower blocks are attached to the bottom chord of the arch centers, near the tip. After the wedges have been lowered, the pressure is released from the center pin by lifting the centers with the above described tackle and the pin is removed. Then the centers are lowered into a horizontal position, the speed of lowering being regulated by the brakes on the winches.

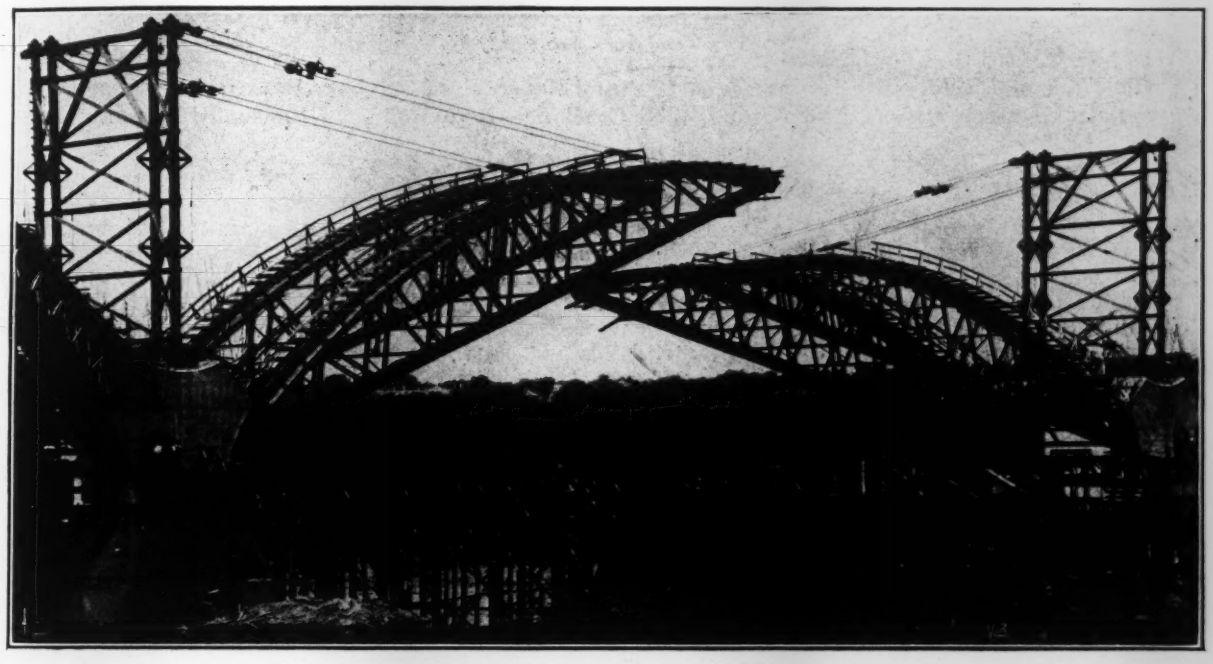


FIG. 5—RAISING STEEL ARCH CENTERS

With the centers in a horizontal position the wind bracing is removed and they are skidded out transversely, a quarter at a time, on greased rails onto two standard-gage steel trucks of 80 tons capacity. These trucks stand on the crane track, which parallels the center line of the bridge at a distance of 39 ft. and at approximately the elevation of the springing line of the concrete arches. The centers are then pulled forward along the crane track to the third span ahead, where they are again skidded transversely to position in the new span. The wind bracing is then replaced and the centers are raised again as has been here described.

This bridge was designed by Walter H. Wheeler and the C. A. P. Turner Co., associated, of Minneapolis, and is being built under their supervision by the Koss Construction Co., Des Moines, Iowa. All of the above special equipment, with the exception of the arch centers, was designed by the writer, as resident engineer for the contractor.

DOWNTOWN MIAMI DURING THE BUILDING BOOM IN EARLY SUMMER 1925 MEYER-KISER FRAMEWORK IN CENTER

The Florida Hurricane and Some of Its Effects

—*Report on a Brief Engineering Reconnaissance*

(*Concluded from Oct. 7, p. 586*)

Tile Walls of 15-Story Realty Board and 17-Story Meyer-Kiser Buildings Racked and Frame of Latter Severely Distorted—Floors Show No Cracking—Both Buildings Unusually Narrow

By F. E. Schmitt

Associate Editor, *Engineering News-Record*, New York

STORM-WIND effects as exhibited in the two damaged office buildings in Miami, the Realty Board Building and the Meyer-Kiser Bank Building, are of separate interest from the general structural effects seen in the Florida hurricane region. Both buildings are unusually narrow. The Meyer-Kiser Bank Building, facing south on First St., east of First Ave., northeast, is 17 stories high and 39 to 45 ft. wide at its widest point. The Realty Board Building, facing west on First Ave., between Third and Fourth Sts., northeast, has the same front width of 45 ft. but is two stories lower. Out of about two dozen high buildings in Miami, these two are the only one showing material structural effect. The following describes their condition as gathered from a somewhat brief examination. Some views of the two buildings were shown last week, but a few additional views are given herewith.

Realty Board Building—The 15-story Realty Board building (see floor framing plan, Fig. 1), stands about three blocks from the water front and has practically open exposure in all directions. Its structure comprises steel frame, 8-in. hollow tile walls, tile-and-rib floors with 1½-in. concrete topping, and 4 to 6-in. gypsum block partitions. The outer faces are plastered on the tile.

This building is extensively cracked in the walls of the lower four or five stories, and its rear wall shows by spalling of the stucco plastering especially along the lines of the floor girders up to about the tenth floor that the coherence of the tile walls was shaken for much of its height. When plumbed, the building was found only ⅛ in. off true vertical, which was believed to show the frame undistorted.

Cracking of the outer walls appears most markedly at the salient corner of the side wall offsets, at the back wall, and in the lower two or three stories of the front. Both corners of the rear (east) wall are split off ½ in. or more for a story height, and the south panel in the first story is out; plaster spalling indicates shear movement in the tile masonry for a considerable height. The side walls show cracking or bulging at a few points in the lower stories. Inside, a number of partitions cracked or fell down in the first three stories and in the fourteenth. Marble wainscoting in the first floor lobby moved out of position, and much marble base trim is loosened. On the second floor a 6-in. slab of base trim extending north and south along a short cross-corridor near the back of the building moved 2¼ in. to the south, out into the main corridor, evidently traveling

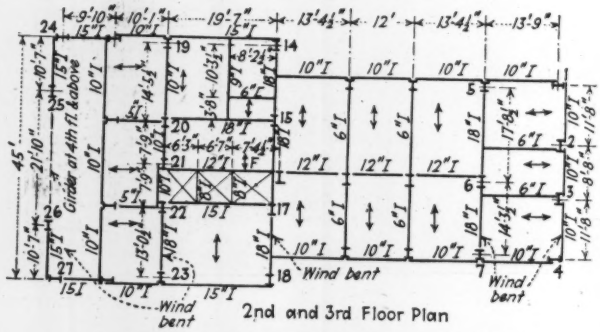


FIG. 1—TYPICAL FLOOR PLAN OF REALTY BOARD BUILDING

Front wall, at left, located on curb line and formed into a three-story arcade with central archway higher than the two side arches. The middle panel of the front wall has no girder below the fourth floor, while the side panels have no girder below the fourth floor. The transverse bent back of this wall, on the building line, extends up to the third-floor level only. The wind bents are located in front and rear walls (bents 24-27 and 1-4), at the offset (bent 14-18) and just ahead of the rear wall (bent 5-7). The rear part showns the most extensive wall cracking.

lengthwise by successive small impulses. The penthouse containing the elevator machinery and water tank had several tile walls crushed in.

Physical evidences as well as the observation of the superintendent indicate that the structure was damaged from the south. The superintendent, who was in the building throughout the storm, says that the main damage occurred during the second half of the storm, and that, while the wind blew a hurricane all the time, a constant succession of violent gusts struck the building and caused active and extreme swaying. The marble wainscoting and trim on some of the partitions worked back and forth in constant slow movement. The swinging lower sections of the windows, all securely latched early in the evening, blew open during the night and

allowed rain to drive in and wet the building through.

A point of importance is that none of the floors or ceilings shows injury. This indicates that the building distorted integrally and the floors were rigid and strong enough to transfer wind forces from bent to bent.

Meyer-Kiser Building—The 17-story building, the lower of which floors are occupied by the Meyer-Kiser Bank and which bears its name, has exactly the same front width (45 ft.) as the Realty Board building, but is longer (140 ft.), as shown more fully in the typical

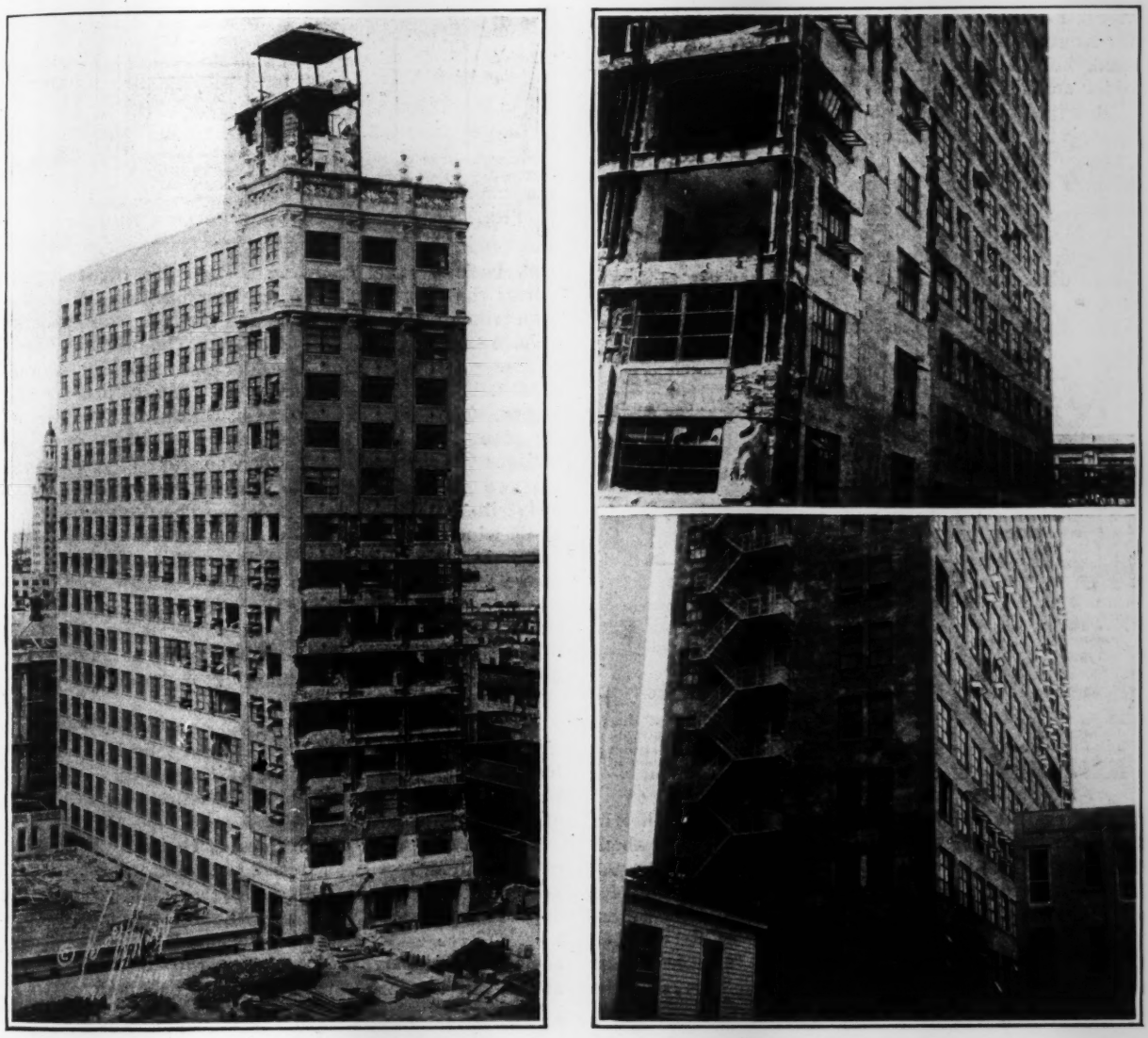


FIG. 2—SOME DETAIL VIEWS OF MEYER-KISER BANK BUILDING
Front wall from southwest. Southeast corner in lower part of distorted zone. Tile rear wall considerably cracked.

The lateral bracing of the building is provided by beam connections in front and rear walls, in bent panels 19-20 and 22-23, bent 14-18 and bent 5-7. The front wall girder system is incomplete up to the fourth floor, because of openings. The design was made for 20-lb. wind pressure at the working stresses fixed by the city building code, which allows 24,000 lb. per sq.in. combined load and wind stress in beams and about 21,000 lb. combined stress in columns. The columns of the wind bents in the first story range from built I-sections with 12x$\frac{5}{8}$-in. web and four angles 6x4x$\frac{7}{8}$ in. (columns 2 and 3) to a similar section with 12x$\frac{1}{2}$-in. web, four angles 6x4x$\frac{3}{4}$ in. and two flange plates 14x$\frac{1}{2}$ in. (column 6).

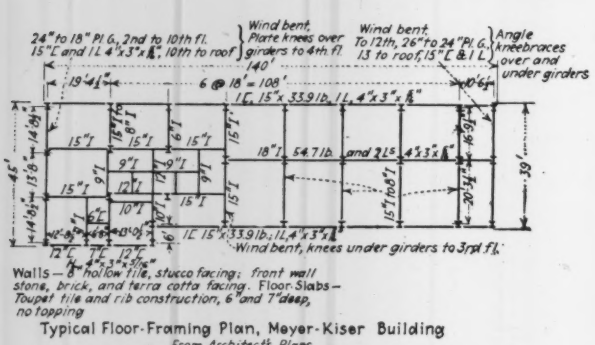
floor framing plan, Fig. 3. Its constructional elements —frames, walls, floors and partitions—are closely similar to those of the other building, but the tile and rib floors were specified to have no concrete topping.

This building is very badly distorted. As reported a week ago, at the front (south) wall it is bent some 20 to 24 in. westward, the bend occurring mainly between the fifth and thirteenth floors, below and above which the alignment is practically plumb; and at the rear (north) wall about 8 in. *eastward*. It is also bent backward (north) some 6 in., all as sketched in Fig. 4. The front wall masonry is gone from the fifth to the eleventh floors, exposing the steel columns and girders;

a few side panels at the front and just back of the offset of the east wall are also out. In the interior, the cracking and destruction of partitions correspond to the visible frame distortion and the outside wall damage. The elevator and stair well tile partitions are extensively shattered from the third to the thirteenth or fourteenth floors, the damage here being a close index of the lateral and lengthwise distortion of the building. On the other hand, neither floors nor ceilings show damage, even minor cracking.

How the steel frame distorted is apparent only at the front wall, where columns and girders are exposed. The typical form of distortion is sketched in Fig. 4. The columns are bent sharply just above and below the floor girders, while the girders remain horizontal and straight, the columns sloping from floor to floor between the bend points. In the two or three stories of the most severe distortion the slope of the columns is in excess of 3 in. per story.

The longitudinal or backward distortion of the structure is localized roughly in the same part of the height as the transverse distortion, but it does not exceed about ½ in. per story.


24" to 18" Pl. G., 2nd to 10th fl.
15" L and 1 L 4"x3"x⅜", 10th to roof
Wind bent, Plate knees over girders to 4th fl.
Wind bent, To 12th, 26" to 24" Pl. G., 15 to roof, 15" L & 1 L
Angle kneebraces over and under girders
140'
6 @ 18' = 108'
19'-4½"
10'-6"
1 C 15"x 33.9 lb. 1 L 4"x3"x⅜"
45'
39'
18" 54.7 lb. and 2 L5 4"x3"x⅜"
1 C 15"x 33.9 lb; 1 L 4"x3"x⅜"
Wind bent, knees under girders to 3rd fl.
Walls—8" hollow tile, stucco facing; front wall stone, brick, and terra cotta facing. Floor Slabs—Toupet tile and rib construction, 6" and 7" deep, no topping

Typical Floor-Framing Plan, Meyer-Kiser Building
From Architect's Plans

FIG. 3—FLOOR PLAN, MEYER-KISER BUILDING

From architect's original plans as filed with the building department. A number of changes were made in construction, but the general arrangement and the essential proportioning were apparently retained. The main wind bents are those in front and rear walls and the bent just back of the offset.

Bracing was provided mainly by the column-girder connections of the front and rear walls and the transverse bent back of the offset. The bents located between the latter and the rear wall may have furnished some bracing action, as is true also of the side bays of the

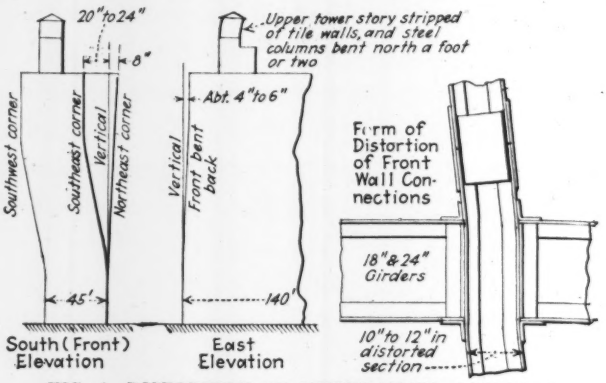


FIG. 4—DISTORTION OF MEYER-KISER BUILDING
Diagrammatic and exaggerated.

bent back of the front wall. In the three lower stories the front walls and the bent back of the offset have triangular knee brackets and the rear wall appears to have extensive bracket stiffening. The original plans as filed with the building inspector were modified during construction, and the details of the changes are not on record. The columns in the front bent are given by the file plans for fourth to sixth floors as 12-in. built I-sections ranging from 12x⅜-in. web, four angles 6x4x½ in., two plates 14x¼ in.; to 12x½-in. web, four angles 6x4x⅝ in., and two plates 14x⅞ in. The design was for 20-lb. wind pressure at the working stresses mentioned.

The four-story machinery and tank house on the roof shows extensive damage to its tile walls for the lower three stories, and complete destruction of the walls of the topmost tower story; in the latter story, the four 6-in. columns (of built I-section) are bent sharply to the north, carrying the uninjured roof pyramid with its sheathing (stripped of its tile).

As already mentioned, partition cracking or destruction is very extensive in the forward portion of the building. Beyond the middle of the length, however, the damage is slight and above the tenth floor this part of the building is intact.

Because of its distortion, showing that the yield-point of the column steel was passed but seemingly not by a great amount, this building offers the most favorable opportunity for a definite quantitative estimate of the lateral force exerted by the storm. It is known that some of the damage was caused in the first half of the storm, but the larger part in the second half, so that

FIG. 5—CONCRETE BLOCK WALL BLOWN OUT WITHOUT DISTURBING FURRING AND LATH

FIG. 6—BLOCK WALL OF AUDITORIUM PARTLY WRECKED AND ROOFING TORN OFF

for the purpose of the calculation it may fairly be assumed that at least in the most seriously affected stories, the front wall masonry resistance had disappeared before the later stages of distortion of the steelwork, and only the resistance of the steel columns was then active.

Summary of Observed Effects—The various facts evidenced by the racking of these two structures, in relation to the structural nature of the buildings, may be summarized as follows:

Severe lateral distortion occurred in the frame of the Meyer-Kiser building and was accompanied by breaking-out or cracking of the wall masonry in the region of material distortion. Apparently the lateral pressure after destruction of the wall panels exceeded the yield-point bending strength of the columns by a small amount and brought about the finally resulting bend in successive steps.

Similar lateral distortion in the Realty Board Building cracked the walls without exceeding the yield strength of the frame, the walls apparently being considerably more rigid than the frame.

Longitudinal bending of the Meyer-Kiser building, accompanied by longitudinal cracking of the walls, indicates that contrary to the common view longitudinal wind bracing requires consideration.

A remarkable degree of horizontal girder action was displayed by the floors of both buildings.

Bending of the upper story of the roof tower of the Meyer-Kiser building will permit calculating the wind pressure during the most severe period of the storm with fair degree of approximation. A check on this may be obtained by calculation of the lateral bending resistance of the front-wall bent of this building, though the distribution of load between this and other wind bents introduces a considerable uncertainty. Approximate figures based on unverified sections indicate an effective wind force approaching 55 to 65 lb. per sq.ft.

Damage and Reconstruction at Fort Lauderdale

How One of Florida's Storm-Wrecked Communities Was Brought Out of Chaos—A Typical Hurricane Experience Described by an Engineer

By G. R. Solomon

Solomon, Norcross & Kess, Consulting Engineers to the City of Fort Lauderdale, Fla.

FORT LAUDERDALE is 46 miles south of Palm Beach, 26 miles north of Miami, and with Hollywood bordering it on the south, caught the full force of the Florida hurricane of Sept. 18. It occupies a narrow strip between the ocean and New River Sound, one of the principal outlets for the waters of the Everglades. The ground is very flat, 2 to 20 ft. above low tide, and the main business area is only 6 ft. above tide.

Work of the Storm—Well-built structures weathered the hurricane except for minor damage such as broken windows and displaced roofing and shingles, while those of substandard construction were generally wrecked. The number of buildings destroyed was large but the money loss is comparatively small, as the principal destruction was confined to smaller buildings of concrete block and frame construction. A large percentage of the concrete block structures were demolished; absence of interlock and the use of poor mortar were the weak points. The older frame houses generally withstood the storm, but many of the small frame buildings, erected during the boom period, with little regard for proper bracing, were blown to bits early in the storm.

The storm raged at hurricane intensity for about nine hours. Across the Gulf it hit Pensacola with almost the same force and raged there for a longer period but did very much less damage than in Fort Lauderdale, Hollywood or Miami, one of the reasons being that Pensacola has a more strictly enforced building code.

The actual damage is far less than first reports indicated, though it is bad enough. The remarkable thing is that so many houses could be wrecked with so little loss of life; the death list stands at eleven. A careful survey by a committee of eight experienced builders, contractors and architects showed that 3,170 houses within the Fort Lauderdale area had been damaged and the estimated cost of repairs and replacement is $3,570,000. This is only one-third of the amount first estimated. But the contents of nearly every house suffered to some extent, for wherever a window was broken by the wind or flying debris, rain was driven into the house and the decorations and furniture necessarily suffered; the greatest loss may be from this source rather than from structural damage.

Flood Damage—Fort Lauderdale suffered also from flood damage. The tremendous volume of water from the Everglades, which finds one of its principal outlets to the Atlantic Ocean through New River Inlet at Fort Lauderdale, was held back by the force of the hurricane and driven over the city so that the greater portion of the business area was 2 to 4 ft. under water. In seeking passage the waters cut a new channel just south of the Inlet jetty and another from Bay Mabel to the ocean through an old abandoned channel which had been closed for years, some two miles south of New River Inlet.

The flood waters receded late on Saturday, Sept. 18.

Intensity of the Storm—The storm assumed hurricane proportions about 2 a.m. Saturday and continued until noon. The barometric pressure reached a low record for the United States of 27.75. The amount of rainfall was difficult to determine due to the great velocity of the wind; it seemed to be raining horizontally instead of vertically.

All the trees along the beach were stripped of their leaves by the sand and wind, and the bark of the Australian pines along the Dixie Highway, three miles west of the ocean, was blasted until the trees looked as though they had been sandpapered. The prized planting and vegetation of many years' standing were totally destroyed. Coconut and royal palms were ruined, though a number of palmetto palms withstood the force of the wind.

The high wind picked up the sand and drove it with the effect of a sand blast against all exposed surfaces. Paint was scoured from automobiles in a few minutes. One of the members of our engineering force ventured

out into the storm early Saturday morning after protecting himself with heavy sweaters and coats, with a galvanized iron water bucket over his head as a sand helmet. Before he returned to the house the metal rim of the bucket was cut through by the sand.

Water Supply—Pending completion of the new waterworks system, Fort Lauderdale is served from two emergency plants, the old station and the new temporary Fourth St. plant, put into operation last spring. The latter is supplied by two 10-in. wells 90 ft. deep, from which water is delivered by air lift to a softening plant consisting of eight 32-ft. circular concrete tanks, 25 ft. high. From these the softened water is collected in a 50-ft. circular concrete clearwater well, 8 ft. deep, from which two motor-driven 1,000 g.p.m. centrifugal pumps take suction and discharge into the distribution system. This station, which takes its current from the lines of the Florida Power & Light Co., was put out of commission by flooding even before the current went off. Its floor is 7 ft. above mean low tide, but the backwater from the Glades stood more than 3 ft. deep on the floor, drowning out the motors. The building, a temporary structure of galvanized iron, was wrecked, the switchboard and other accessories being destroyed. The crew rebuilt the station within five days.

As soon as the storm had abated so that the men could reach the old plant, which had not been in regular use since Spring, its oil and gasoline engines were bailed out, and by Sunday morning water was available and service was maintained continuously, except for the necessary shutdowns due to broken mains. The greatest difficulty was due to leakage in the house services where buildings had been destroyed and the pipes broken, and to leaks in the mains where the force of the storm had uncovered the pipes, broken the joints or wrecked hydrants.

Four repair gangs were organized on Saturday afternoon and the city was divided into districts. By shutting off the valves immediately around the pumping station, these gangs concentrated their efforts and were soon able to test out lines and shut off broken house connections; by Monday the principal portions of the city had water.

A 16-in. line crossing under New River Sound and the Florida East Coast Canal was not damaged, but a 12-in. line along the Ocean Boulevard was completely uncovered after the curbing, paving and roadway were destroyed. The joints were broken and the lengths of 12-in. pipe thrown inland with other wreckage.

Elevated Tanks—Two steel elevated tanks and towers withstood the storm, although the roof of one was blown off and carried about three blocks. The other, which was in one of the most exposed points in the city and bore the full brunt of the wind, had two of its legs loosened from the foundations and moved about 2 in. The anchor bolts held, however, and aside from the spalling of the foundations no serious damage was done.

Wire Lines—Fort Lauderdale is supplied with electric current by the Florida Power & Light Co. A local station driven by Diesel engines supplied the city until January, but since that time current has been transmitted from the company's Miami and West Palm Beach stations. Destruction of electric lines was general.

The power company has had large gangs of men, recruited from all parts of the South, at work night and day since the storm, with the result that current was available in some portions of the city within a few days, and eleven days after the storm the whiteway along the principal business street was lighted for blocks.

The hurricane practically destroyed all telephone and electric wires which were above ground and only a few telephones are yet in operation. Telegraphic service was re-established within six days.

Sewers—There are only a few miles of sanitary sewers which discharge into New River, the remainder of the city being served by septic tanks. As both systems were drowned out, there was great danger of contamination of the numerous surface wells in those parts of the town not served by the water mains. Two storm drainage canals emptying into New River and about three miles of storm sewers serve the city. These were totally inadequate. The new construction program for water supply, sewers and other municipal improvements for which bonds have been voted and contracts partly let, will probably be delayed until the relief and rehabilitation program has been carried out.

Relief Measures—It was at once appreciated that drastic relief measures would have to be enforced in order to prevent disease and protect the public health. Committees were organized under the Red Cross, the U. S. Army Medical Corps and the local civic organizations. The section chiefs were given police powers and authority to make any necessary expenditures which emergency conditions demanded. F. J. Keis of our firm, who is in active charge of our Fort Lauderdale office, was made responsible for maintaining the water supply.

Our entire engineering organization was placed on this work, and as a result of their labors the city had water. It was the only coastal city north of Miami, in the hurricane district, where a municipal supply was in operation. Through the State Board of Health, an emergency supply of chlorine and hypochlorite of lime was obtained and the water kept sterile. Placards were posted all over the city forbidding the use of water from wells which had not passed a satisfactory analysis and stressing the need of chlorination of all water used for drinking purposes. An emergency force was kept busy making analyses of existing wells, and where the water showed evidences of contamination the well was at once condemned and police measures taken to prevent its use.

Notice was given that septic tanks were useless in the water-soaked soil and that chloride of lime and instructions for its use as a sanitary measure could be obtained at the relief headquarters.

The city building inspector made a quick survey of the damaged buildings and condemned such as he considered in a dangerous condition. Warning placards were posted, giving notice of their condition and requiring the consent of the building department before straightening or rebuilding any damaged structure.

Medical and relief stations were established at various points for treating wounds, for vaccination against typhoid and for providing meals, clothing and temporary housing for the destitute. The Pullman Co. placed sleepers and diners on sidetracks and took care of many refugees without charge. The Florida East Coast R.R. supplied a wrecking crew of fifty men to assist in clearing the streets and demolishing dangerous structures.

Martial law was declared and every ablebodied man put at some useful task of rehabilitation, so that one week after the storm the streets were cleared, relief measures well organized and the city well on its way toward rebuilding.

Civil Engineers Hold Six-Day Meeting in Philadelphia

Main Sessions Given International Flavor and Technical Sessions Largely Devoted to Historical Reviews in Honor of Sesqui-Centennial Celebration—No Business Transacted

TAKING the Sesqui-Centennial Exposition celebrating the 150th anniversary of American independence as a cue, the American Society of Civil Engineers turned its regular quarterly fall meeting into an Annual Convention at Philadelphia, which lasted six days, from Oct. 4 to 9. Nearly 1,150 members and guests registered during the week, which is a record for any but the meetings which are held every January in New York, but few of these stayed the whole week. On account of the assignment of the first part of the week to general subjects and the latter part to technical divisions, the attendance increased rather than decreased towards the end. Fully as much, if not more, attention was paid to the social events as to the technical. The meetings were held only in the morning. Every afternoon was devoted to an excursion and every evening to some entertainment. Arrangements were made for group luncheons and dinners on each day, and on Saturday an excursion was taken which lasted all the day. Non-technical activities included boat rides on the river, visits to the Sesqui-Centennial Exposition, military and naval exhibitions by the armed forces located at the exposition, a luncheon at a department store, a trip through the subway under construction and luncheon in the subway, a visit to Valley Forge, trips around Philadelphia's historical buildings and excursions through a large newspaper plant and through a locomotive works. The schedule for all these trips was rigorously maintained. If any conflict between the technical sessions and the excursions seemed imminent, the technical session had to give way.

The first two mornings were devoted to a general session, the first morning being entirely given over to formal addresses of welcome and response. On Tuesday morning, the general subject of 150 years of engineering was discussed first in the annual address of the president, George S. Davison, and, second, in a paper sent over by Dr. Matchoss, of the German engineering museum. Harrington Emerson, New York City, representing the French civil engineering society in the absence of any French member lauded the French spirit and George A. Walkem, president of the Engineering Institute of Canada, represented that society, but on account of the imperative necessity to start the afternoon excursion, Colonel Walkem did not have opportunity to make his address, except as a speech at the banquet on Friday night.

The only business that was transacted in open meeting was the presentation of the report by the committee consisting of the Directors of the Society on a new method of nominating officers. It will be remembered that at the January meeting three mutually exclusive amendments were presented with a view to revising the current method. That meeting referred the whole matter to the directors for report. The substitute amendment now proposed provides that the nominees for directors and vice-presidents shall be selected by the same method as that now in effect and that the nominee for president be selected by a committee consisting of the directors and the two last living past-presidents. Provision is made that no member of the nominating committee shall be eligible for the presidency until at least two years after the expiration of his term as a director. The business meeting adopted the recommendation of the committee that the report be referred for further consideration to the annual meeting in January.

Local Sections—Some 30 representatives of the local sections met in conference which took all of both the morning and afternoon of Wednesday. This conference was presided over by Henry D. Dewell, a member of the Board of Direction and chairman of the Committee on Local Sections. While the proceedings followed a program set up by the committee, the meeting was largely an open forum for the discussion of all matters connected with local section work. Representatives of the local sections told what kind of work the sections were doing and what they would like to do. No definite action was taken, but the report of the meeting should be of value to the Board of Direction in its consideration of local section activities.

Technical Divisions—The usual large number of technical division meetings was held. On Wednesday there were simultaneous meetings of the highway, power and sanitary divisions and of a new division on surveying and mapping which was attended very sparsely. On Thursday, the city planning division met, there was a joint meeting of the construction and structural divisions, and a meeting of the sanitary division. On Friday, city planning met once more and construction and structural had a joint meeting, although they were scheduled to be separate but not enough people showed up at the construction division to warrant the meeting, at which arbitration was discussed. A waterways division meeting also was held on Friday.

Structural—At a joint session of the structural and construction divisions, which incidentally represented a distinct simplification of program, the half-century's progress in bridge engineering and building construction was reviewed by two eminent engineers, Ralph Modjeski, chief engineer of the just completed Philadelphia-Camden bridge over the Delaware River, and William A. Starrett, building contractor.

Taking as his subject "Fifty Years of Building Construction," Mr. Starrett divided the half century into three periods; from the Philadelphia Centennial Exposition in 1876 to the Chicago World's Fair of 1893, the period thence to 1914 (beginning of the World War), and the present period. The first period was sketched by Colonel Starrett rather humorously with descriptions of the primitive architecture and engineering of the Centennial Exposition. At that time there was no reinforced concrete or cement, no electric light and power, the telephone was an exhibit curiosity, and the time of modern cheap and large-scale structural steel was still in the future. In the 22 years after the Chicago World's Fair the outstanding feature of construction as of the country's development as a whole was gigantic growth.

Structural steel came in at the beginning of this period, and reinforced concrete immediately afterward; the steel-frame high building passed out of its infancy, and the passenger elevator kept pace with it in its development. New materials were created to suit the new building art, electric light and power were introduced, and heating and ventilation were adapted to the new problems. In the third period, the whole status of building and all ideas concerning it were revolutionized by the World War, and after the war there followed an economic revolution in building, due to vast operations and city growth, and unprecedented obsolescence of older buildings in competition with the new. He compared some phases of the present growth to a trailing blackberry, growing forward and dying out behind.

Mr. Modjeski spoke on "Fifty Years' Progress in Bridge Building, with Special Reference to the Delaware River Bridge." His outline of the elements of progress during the half century constituted a background to the reasoning and the choice of form and design in the planning of the Delaware River bridge. The outstanding items of the 50-year growth, Mr. Modjeski said, were better protection for men in the construction of deep foundations, the improvement of erection machinery, application of alloy steels, and the development of a better understanding of design. Dealing in some detail with each of these, he laid stress on the use made of alloy steels: Chrome steel, in the Eads bridge, nickel steel in the Manhattan, Quebec, Metropolis, and Hell Gate bridges, Mayari steel in the Memphis bridge, and finally the newer but somewhat less strong material, silicon steel, in a considerable number of bridges. Of these, nickel steel is used in the chords of the stiffening trusses of the Delaware River bridge, and silicon steel in the webs of the trusses and in the main towers.

Mr. Modjeski characterized advance in superstructure engineering by saying that at the opening of his 50-year period the Brooklyn bridge, ever notable as an example of courageous pioneering, was under construction as the world's longest span, while today we discuss 3,000 to 4,000-ft. spans with perfect assurance. The influence of demands for rapid erection upon bridge design was indicated, and the great development of the cantilever traced in part to the erection problem; but the author described the suspension bridge as the predominant type for long spans, and then showed how the faulty elements and weaknesses of the early bridges, such as the Brooklyn, were later recognized and studied and were eliminated in the Delaware River bridge. Fixed saddles have been substituted for the roller-mounted saddles, expansion joints in the trusses are eliminated except in the form of rockers at the towers, flexible steel towers replace the fixed stone towers, top bracing is eliminated, and two cables replace the four, permitting the provision of a clear roadway.

Prof. H. M. Westergaard, of the University of Illinois, at a second session of the division presented an elaborate review of the development of structural analysis during 150 years. Navier's studies, the work of such men as Rankine, Maxwell, Culmann, Mohr, Müller-Breslau, and others, were succinctly indicated and correlated. The paper promises to be a most illuminating addition to modern structural literature. Like the other papers unfortunately it brought no discussion.

The remarkable work done in foundation studies and construction and in the superstructure design of the Richmond power station of the Philadelphia Electric Co., was described briefly by the engineer, Frank N. Kneas. This enormous structure, located on a mud flat of the Delaware River a few miles north of Philadelphia, presented a formidable foundation problem, rock being 60 to 100 ft. down. The problem was boldly solved by the adoption of spread footings on sand strata at relatively shallow depths, but before such a decision could be made it was necessary to carry out elaborate studies of sub-surface water and its flow. The solution proved entirely successful, and resulted in great economies of time and expenditure.

Waterways—The Waterways Division began its session too promptly for most of the members and as a result Maj. Gen. W. M. Black began reading his paper on progress in waterways engineering during the past fifty years to only a handful of men. However, the number soon increased to about fifty. The paper, with its many references to other papers, books and data will be found to be an excellent source of information on waterways.

Col. F. C. Boggs followed General Black with a long and detailed paper on the improvements of the Delaware River below Philadelphia in which he added data on the cost of dredging to that already given by General Black. The paper closed with an estimate of the unit cost of the improvement work to the increased tonnage brought to Philadelphia by the deepening of the river, a figure which Colonel Boggs put at $0.214 per ton. Discussion which followed the reading of the papers centered upon the theories used as a basis of the channel improvement work in the Delaware River and upon the figures given by General Black and Colonel Boggs on the cost of dredging. The general opinion seemed to be that the figures were too low to use as a basis for contract work as they did not include contractor's profits or depreciation, overhead for engineering officers or insurance. In defense of the low figures given by the army engineers it was stated that government dredges could be kept in operation more continuously than was possible in the case of a contractor who must depend upon the irregular work which he can get by bidding against others.

Power—One subject occupied the whole time of the Power Division, both at the technical session on Wednesday and at the all-day excursion on Thursday. It was the great hydro-electric power development on the Susquehanna River near Conowingo, Md. The technical session, with about 140 attending, heard five papers, the first a general description of the whole development, by Alexander Wilson, 3rd, the construction engineer of the Philadelphia Electric Co., and the others giving more details of certain phases. Dr. William C. L. Eglin, vice-president and chief engineer of the Philadelphia Electric Co., in the first of the latter papers emphasized the enormous amount of preparatory work necessary in the studies of possible sites and in reports for the various commissions having jurisdiction over the development. He was followed by H. A. Hageman, hydraulic engineer, Stone & Webster, Inc., who described the features of design in the power station and hydraulic equipment. J. V. Hogan, chief engineer of the Arundel Corporation, and A. V. Clark, works manager, Stone & Webster, then described the construction methods on the work under their charge. Their descriptions were supplemented by a motion picture of the work.

On Thursday about fifty members of the division went down to Conowingo and spent the greater part of the day going over the development.

City Planning—Regional planning was the keynote of the technical program of the city planning division. More than two dozen people were scheduled to present 5-min. discussions of the four papers printed, and practically every man was on hand or sent a written discussion. The two meetings were attended by 75 to 100. Of the principal ideas brought out the following were the more salient: Co-operation with officials of those governing bodies who must carry out the ultimate programs proposed, a statement as to information to be collected and the mechanics of its portrayal and the criteria as to its necessity, selection of certain definite projects rather than a completed plan to put before the community, payment of improvements by more direct means than by taxes, the distinction between the corrective measures more often essential in city planning and the possibility of preventive measures in regional planning of immediately acquiring property particularly for traffic ways and the coming wave of opinion toward legal preservation of open spaces.

An attorney, Andrew Wright Crawford, secretary of the Philadelphia Art Commission, furnished the fireworks of the second session by charging the engineers with all the "drab, stupid, stale rectangularity of the checkerboard cities" for the last century. He stated in his paper on "Cultural Opportunities in Regional Planning" that the architects will have pushed the engineers down to a subordinate position of calculating stresses and strains unless they learned how to "design." Designing he inferred was shot through with art and the engineer was eminently fitted to take on the more cultural attributes but if he did not he was only a skilled workman. Morris Knowles, consulting engineer, Pittsburgh, summed up the storm of protests that arose by saying that there is plenty of evidence around us of the use by engineers of all the cultural talents available, as for instance in the Camden bridge. Furthermore there always would be various grades of engineers as there always would be mediocre, average and cultured architects.

Thomas Adams, director, Regional Plan of New York and Its Environs, presented a masterly forecast of the regional community but he did not trust prophecy far in the future with two-thirds of his paper devoted to present problems. Some of the more striking things predicted are as follows: Reformation of old cities forced by competition of new ones, more and more direct transportation arteries with the different types co-ordinated, elimination of parking leaving roadways for fluid traffic, elevated highways over railroads, elevated sidewalks, areas zoned for agriculture, regional co-operation to end pollution of drinking water and build sewage disposal plants, highway grade separation, a reaction against high buildings and apartments, better control of land speculation and more even adjustment of taxes.

Harold M. Lewis, executive engineer, Regional Plan of New York and Its Environs, presented an excellent summary of the basic information needed for a regional plan, most valuable because of the large number of lately organized regional plan commissions. Four of the five years his organization has been in existence have been spent in surveys and gathering data. No precedent existed to indicate what was essential; in consequence, he frankly stated, much material will remain buried in the files but other communities may profit. His suggestion of scales of maps is of distinct usefulness. Wall maps are 1 in. to the mile for large regions and 2 in. for smaller areas. Table maps are ½ to ¼ in. and detail sectional maps 1 in. to 2,000 ft. for large regions and 1,000 ft. for small regions. A trick used is that of coating base maps with a transparent celluloid coating to permit studies in oil colors, crayons or soft pencil, easily wiped off with a wet or oil rag if revisions are desired. Photostats of uniform letter size bound with descriptive text are bound together for ready reference.

Both sessions were joint meetings with the American City Planning Institute, Morris Knowles of the Am. Soc. C. E. presiding on Thursday and E. M. Bassett of the Institute officiating on Friday.

Sanitary—Two widely divergent plans were followed in choosing topics for the sanitary engineering division. The papers at the Wednesday section were designed to present 150-year reviews in seven fields of sanitary engineering, while at the Thursday morning session there was a symposium on industrial waste disposal, devoted chiefly to current phases of the subject as regards four classes of waste. The historical reviews went over ground quite familiar to any well informed sanitary engineer and wholly so to competent specialists in each of the seven fields of sanitation. Those who specialize closely would find much to interest and inform in the papers on other than their own specialties, while for engineers in say the structural or power fields the whole group of papers would be informing—if heard, which they were not—or if read in the *Proceedings*—which it is to be hoped they will be. In contrast, the symposium on industrial wastes, dealing with current practice and problems, was of direct appeal to all engineers working in that field, besides containing much information which should interest any broad-minded engineer.

In the 150-year review paper group, George W. Fuller dealt with water-works, Harrison P. Eddy with sewerage, Samuel A. Greeley with refuse, S. H. McCrory with land drainage, J. A. LePrince with land drainage and Dr. George T. Palmer with ventilation. There was no real discussion, either on this or the other group of papers, but the chairman called on one person for comments with an appeal for brevity—in view of the imperative urge to close sharply at 12:15 for the prearranged luncheons. There was a minute and a half left for general discussion after the second session but no one had the temerity to attempt to express himself in so brief a time and face a shutdown if he ran over. Broadly, those who presented formal discussions agreed with the authors of the set papers, the chief if not the only exception being afforded by Thornton Lewis who urged that the open window should not displace mechanical ventilation until there is more certainty as to the former than he felt to be the case as yet.

The symposium on industrial wastes was introduced by W. L. Stevenson. Papers on the four specific wastes were read as follows: oil refinery, Robert Spurr Weston; coal mine drainage, Andrew B. Crichton; pulp and paper mill wastes, George K. Spence; tannery wastes, Wilhelm Howalt. The symposium stressed the growing co-operation between state authorities and the various waste-producing agencies in the control of pollution and also the industries' own research work.

General Contractors Round Up Construction Reforms

Associated General Contractors Discusses Day Labor, Surety Bonding, Lien Laws and Quantity Surveys at Kansas City Meeting of the Board

PROGRESS in the various activities of the Associated General Contractors was reviewed at the board meeting held in Kansas City, Mo., Oct. 4-7, 1926. Including invited engineers and equipment manufacturers nearly 200 were in attendance—perhaps the largest board meeting ever held by the association. Nominations for officers for 1927 were made, a place for the annual meeting was selected and a program of nearly a hundred topics was considered. Discussions concentrated on day labor, surety bonding, lien law reform, accident prevention and group insurance, quantity survey, standard contracts, and finance. Sumner Sollitt of Chicago, was nominated for president and Leonard C. Wason of Boston as vice-president at large. The records as of Oct. 1, 1926, show 2,133 members; from Jan. 1, the additions numbered 570 and the resignations 281. There are now 85 chapters and branches. The annual meeting in January, 1927, will be at Asheville, N. C. A vote of the Board recommended increasing the executive board to include all past presidents and increasing the advisory board to 25 members.

Surety Bonding and Questionnaires—Report was made that the standard questionnaire of the Joint Conference on Construction Practices had been adopted by three surety companies as a part of their investigating systems. As a group the surety companies have not acted and this puts the companies which have done so at a business-getting disadvantage unless the members support them fully. The report said:

> Unless the responsible contractor is willing to supply adequate information, so that he can be identified as responsible, and so that a proper system of investigation can be established, the five years of effort exerted by the Association seems likely to be wasted. That company or group of surety companies which is willing to take a constructive step for our benefit should not be allowed to fail in the action. Obviously we cannot expect to gain all and give nothing in return.

Hot criticism of surety bonding practices and of the surety companies by the committee members and others was followed by the adoption of the following resolution:

> Your special committee, realizing that the earnest efforts of several years have brought no mitigation of the abuses in bonding practices and that these abuses can only be eliminated by unusual and even drastic procedure, but feeling that the possibilities in the forming of a constructors bonding company are so great and far reaching, recommend that, since any move or conclusion would be premature, no positive action be taken at this time, but that most careful study and serious consideration be given this subject from all angles by the members of Associated General Contractors.

Day Labor—Presentation was made of the new bill restricting day labor construction by federal departments and bureaus as amended by the sub-committee of the Committee on the Judiciary of the House and reported favorably to the full committee. The amended bill in substance is indicated by Section 2, which reads:

> That before expending federal funds on any construction project estimated to cost more than $25,000, and not constituting maintenance or repair, said departments, bureaus, commissions, or other agencies shall publicly advertise, through the usual mediums, for competitive bids to perform such project, and after receiving bids, shall conduct said construction project by contract or otherwise; Provided, however, that if such bids be reasonable in the opinion of said departments, bureaus, commissions, or other agencies, then said departments, bureaus, commissions, or other agencies shall award the contract to the lowest bidder qualified by character, experience and organization to do such work.

In all cases an estimate of cost is demanded as specified in Section 7 as follows:

> That said estimate of cost shall include all fair and reasonable charges for use of construction equipment and all other costs involved by the said construction project, whether paid directly from the specific appropriation therefore or from other funds and whether paid under direction of the specific department, bureau, commission, or other agency having charge of said project or under some other agency; and further that said estimate of cost shall be read and shall become public record at the time of the opening of bids. Also within sixty days after the completion or acceptance of any construction project there shall be compiled a statement of the total expense, together with a detailed statement of any change made in the plans and specifications as well as the time of completion on which the original estimate was based, all filed and made available for public examination in the office of the department in Washington.

Effort will be concentrated by the Association on the consideration and passage of this bill by the House and on a similar bill in the Senate.

Lien Law Reform—Reporting on the lien law and the uniform lien law now being drafted by a committee sponsored by the Department of Commerce the following specific criticisms were made:

(1) The right to collect from an innocent third party makes it unnecessary for material dealers to establish proper credit investigation They can sell promiscuously to any dishonest person and collect from the owner, if that person fails to pay.

(2) No matter how completely the owner pays a contractor or sub-contractor, he is, generally speaking, liable for payment to some party of whom he has never heard, should some other party of whom he has never heard fail to make proper payment.

(3) Liens may be promiscuously filed, even spurious ones, to cloud the title of real estatem.

(4) Spurious liens may be filed for the purpose of injuring business reputations.

(5) The lien is used by irresponsible individuals as a means of extortion against either the owner of construction or those who have financed it.

(6) Priority of the lien over mortgages makes it practically impossible to protect the mortgage, if all liens date from commencement of the work. Under such a provision any party, who furnished material to a structure many months after its commencement, has priority over a mortgage placed even one day after commencement.

(7) Ordinarily the owner cannot, unless he be an attorney or thoroughly familiar with the complicated provisions of the lien law, protect himself against dual payments.

(8) In general no provision is made in the laws to prevent the improper filing of liens, extortion, malicious clouding of title and other abuses, which flow directly from the law itself.

(9) The effect of some of the laws is to induct into and maintain in the construction industry great numbers of individuals who could not obtain credit on their own worth and who bring discredit upon the entire construction group.

(10) Provision is lacking for a prompt placing of liens

and settlement thereof. They may be allowed to drag for months before it is determined whether the lienor has any right to file. Cases are known where liens have been filed for shirts sold to workmen on construction.

Quantity Surveys—Rehearsing experience with commercial and association controlled quantity surveying and unqualifiedly recommending the use of quantity surveys the report and discussion reached the following conclusion:

Few contractors today challenge the usefulness of the quantity survey if properly performed. The Association, however, believes that this work in behalf of the general contractor should be owned and controlled by him rather than by commercial interests. The service confers no advantage whatever to any except those who figure on particular projects and this being true, there seems to be little occasion for the work being performed outside of the jurisdiction of the contractors themselves. Where the contractors maintain the service they are able to control the personnel of the bureau, standardize the take-off, establish equitable charges for the service, maintain close contact and co-operation with the engineers and architects whose plans are computed, and in all respects intimately administer the business in the interest of the elements who are concerned with the service. This mode has a striking advantage over purchase of this service from a commercial company whose objective is profit more particularly than the benefit of service.

Accident Prevention—General discussion rather than a journal report was had on this subject and it included group liability insurance as a component question. Practices in the Detroit, Milwaukee and Texas chapters was brought out by question and answer and action was taken to confer by committee with the National Safety Council. The discussion indicated a growing interest but added little to the knowledge of practices.

Highway Contracting Topics—The half-dozen items which chiefly aroused interest in the discussion of the score or more topics listed were: (1) Estimate sheets, (2) contract maintenance, (3) winter storage of aggregates, (4) standard stone sizes, (5) state-furnished materials, and (6) freight loss from water content of gravel and sand.

A set of eleven estimate sheets prepared by the staff engineer was presented by the committee: (1) A field sheet of items to be considered in investigating a project, (2) An office sheet of items to be noted in the specifications and in the required general plant of operations. (3) A material sheet itemizing the costs entering into materials delivered on the job. (4) A job-overhead sheet itemizing overhead costs seggregated into excavation, pavement and structures. (5) An excavation summary sheet for both classified and unclassified excavation. (6) and (7) A pavement summary sheet of cost items, for slab, fine grading, reinforcing steel, shoulders and sub-grade stone. (9), (10) and (11) Structures summary sheets of cost items for concrete structures, foundation excavation, piledriving, reinforcing steel, waterproofing and pipe structures.

These sheets, being designed to cover all pay items in all state highway department specifications, were presented with the knowledge that they included more items than would apply in any one locality and with the expectation that any particular user should strike out those items not applicable under his conditions. The criticism offered in discussion was that there was excessive detail. Opinion favored few estimate items and correspondingly few cost account heads. Invariably, it was held, estimates and cost records should be capable of direct comparison. Any system should, it was agreed, also enable a frequent check of estimates and costs.

Consideration of contract maintenance took two directions: the possible amount of such work and its possible opportunities for contracting. There seemed to be general assent that from 15 to 50 per cent of maintenance work, including reconstruction could be done by contract. Of these figures the highway engineers inclined toward the smaller. Reference was made to the considerable amount of contract maintenance in Ohio, and it was stated that the practice of the highway authorities would be to increase this amount. Experience in Texas was referred to and the charge was made by engineers from that state that contracts and specifications were very faulty and where political considerations had influenced the selection of contractors the results had been poor. With capable contractors and efficient engineering control, on the contrary, the work had been good. From the contractors' viewpoint it was felt that under the present competitive system all contractors are never fully employed to the capacity of their organization and equipment. The idle contractor or the one who is anxious to expand his business can very well bid upon reconstruction and maintenance work and not allow this added load to interfere with any new construction which he may be awarded. This increased employment of his organization and plant is bound to make his operations more efficient, reducing his prorata overhead and placing him in position to present more favorable bids upon new work.

Advantages were conceded to production and in building up the valley of winter idleness by storing materials in winter for spring road work and by standardizing stone sizes, but for the contractor the advantages were held more doubtful. Both rehandling and deterioration were hazards of winter storage. A contractor might store to advantage, it was considered, so much aggregate as could be handled directly to his work from his original set-up of cranes, derricks, tunnels, bins, etc., assuming no deterioration and also assuming reasonable estimate payments for material delivered but not entered into the work. At best there was some added cost and hazard in winter storage and little advantage so long as he could depend on rail deliveries which in recent years he has been able to do.

There was rather heated protest by the contractors against state-furnished materials, particularly aggregates. It developed, on query by the engineers, that generally there was little complaint on account of tardy or insufficient shipments. The chief counts against the practice were that the contractor should have the right to buy where he wished and take his profit and any advantage in prices he might be able to obtain, and, finally, that the practice was another objectionable instance of government in business. Engineers and contractors were, however, wholly in accord in criticising the railroads for refusal to grant an allowance for water content in washed sand and gravel. A water content of 10 per cent by volume was common when these materials were loaded and weighed. The discussion concluded in a resolution recommending a committee of the association to study the situation and report on ways and means to meet it.

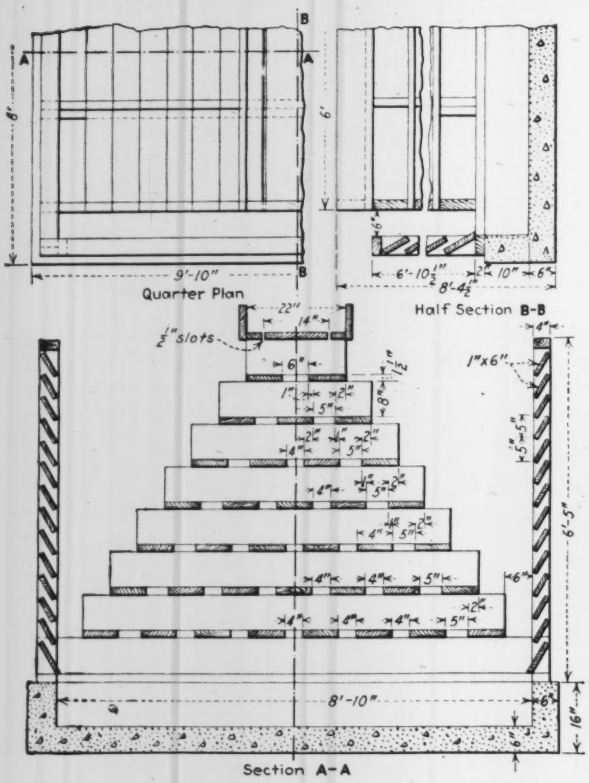
From Job and Office

HINTS THAT CUT COST AND TIME FOR THE CONTRACTOR AND ENGINEER

A Simple Water Aerator

By James L. Barron
Assistant Engineer, State Board of Health, Lawrence, Kan.

NEED has arisen in many small water purification plants for a simple and effective type of aerator. The small plant, built a number of years ago, was not equipped with an aerator, considered essential in most modern plants. At the typical plant, the storage of raw water becomes inadequate due to increased demands, or protracted dry weather. The raw water becomes stagnant with the decomposition of organic and vegetable matter, the oxygen is depleted, excessive algæ growths occur, and the dissolved gases and organic matter produce disagreeable tastes and odors which are only partially overcome by the treatment in use. The result is great dissatisfaction with the water on the part of the consumers and suspicions as to its safety.



PLAN AND SECTION OF KANSAS WATER AERATOR

Designed by Division of Water and Sewage, Kansas State Board of Health. This size for 500 g.p.m. (0.72 m.g.d.) or less. Add 1½ ft. to length for each additional 100 g.p.m. desired. Supply pipe may run up center of stack or be placed at end to discharge horizontally into trough. In either case it is generally necessary to place small wood blocks along the floor of the trough and to vary the opening of the slots with lath to get an even downward flow. Catchbasin to be sloped to collecting pipe or to mixing channel.

To meet this condition, the Kansas State Board of Health has evolved a simple type of timber aerator consisting of an inverted V-stack of horizontal staggered baffles which provide a cascade for the water, giving an even distribution and fine separation of the flow. The aerator requires about 8 to 9 ft. additional pumping head. In its construction, which is a carpenter's job, cypress has been found to be the most satisfactory material.

This aerator has been constructed at a number of Kansas plants with uniform success in clearing up an unsatisfactory condition of the water. It is also being used for the precipitation of dissolved iron in one plant using ground water.

Adjustable Form Shores Used in Raising Warehouse Roof

ADJUSTABLE form shores were successfully used in jacking up the roof of the warehouse of the Fairbanks Fibre Box Co., at Middletown, Ohio, to add more than twice as much clearance as theretofore had obtained. The work was done so that a traveling crane could be installed for handling heavy rolls of paper, and to provide greater storage.

WAREHOUSE ROOF SUPPORTED BY SHORES DURING RAISING OPERATIONS

Note outriggers are placed on the shoring towers to carry walkway for masons during bricking up work.

It was necessary to arrange the construction program so that there would be no interruption to the storage of paper. The trusses had to be raised and the walls carried up and the entire building kept protected from wet weather at all times in order not to damage the contents of the warehouse. The building is 50 ft. wide, 180 ft. long, and the roof is supported by ten 50-ft. trusses.

Towers were first built at each end of each truss and these were laced together to help carry the platform for carrying up the brickwork and also to serve as supports for the shores in jacking up the trusses. Four shores were used in jacking up one end of each truss. The first lift of the truss was about 2 ft. 6 in.

Brickwork was then carried up for that lift and the next lift was made at the opposite wall, this second lift

being 5 ft. In this manner the roof was pitched first one way and then the other until it reached its final position, the brickwork being carried along at the same time until the trusses finally rested on the walls in their new location.

The roof, which was the ordinary composition type, showed no signs of leaks in spite of the warping of the roof during the building operations. The first lift on this building was started May 14, 1926, and the last lift was completed on June 25. About eighty adjustable shores and four jacking devices comprised the only equipment used and the only material necessary was lumber for the towers placed under each end of each of the ten trusses. Frank Hill Smith, Inc., Dayton, Ohio, were the engineers and contractors on the work, with R. N. West as job superintendent.

The material from which this article was written was supplied by the H. W. Roos Co., concrete form specialists of Cincinnati, Ohio, whose adjustable shores were used.

Determining Intersection of Two Lines with Certain Functions Given

By G. I. Gibbs
Brown & Gibbs, Engineers and Surveyors, Asheville, N. C.

In land survey work, we are sometimes able to locate two corners separated by two lines of known direction and one missing corner. In such a case, if the exact intersection is required, it may be calculated by the use of the formula which follows:

The co-ordinates of the two located corners are calculated from an accurate traverse. The bearings of the two lines from the known corners toward the intersection may be established by marked trees or other line marks, these having been "spotted" in running the traverse.

Then let

A = one known corner.
B = other " "
C = unknown " (intersection).
T_a = latitude of A.
T_b = " " B.
T_c = " " C.
G_a = longitude " A.
G_b = " " B.
G_c = " " C.
B_a = bearing of line from A toward C.
B_b = " " " " B " C.
x = length " " " A to C.
y = length " " " B to C.

Then

$$T_c = T_b + y \cos B_b$$

and also

$$T_c = T_a + x \cos B_a$$

Equating these two:

$$T_b + y \cos B_b = T_a + x \cos B_a \qquad (1)$$

Similarly,

$$G_c = G_b + y \sin G_b$$

and also

$$G_c = G_a + x \sin G_a$$

Equating these two:

$$G_b + y \sin G_b = G_a + x \sin G_a \qquad (2)$$

Solving (1) and (2) for y

$$y = \frac{T_a + x \cos B_a - T_b}{\cos B_b}$$

and

$$y = \frac{G_a + x \sin B_a - G_b}{\sin B_b}$$

Equating these two

$$\frac{T_a - T_b + x \cos B_a}{\cos B_b} = \frac{G_a - G_b + x \sin B_a}{\sin B_b}$$

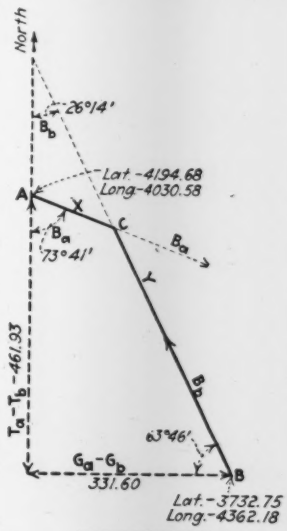
Simplifying: $\text{Sin } B_b(T_a - T_b) + x \sin B_b \cos B_a$
$= \cos B_b(G_a - G_b) + x \sin B_a \cos B_b$

Solving for x: $x(\sin B_b \cos B_a - \sin B_a \cos B_b)$
$= \cos B_b(G_a - G_b) - \sin B_b(T_a - T_b)$

Or,

$$x = \frac{\cos B_b(G_a - G_b) - (T_a - T_b) \sin B_b}{\sin B_b \cos B_a - \sin B_a \cos B_b} \qquad (3)$$

The plus and minus signs must be very carefully watched in the application of this formula. With a northeast bearing the sine and cosine are both plus; with a southeast bearing, the sine is plus and the cosine is minus; with a southwest bearing, both sine and cosine are minus; and with a northwest bearing, the sine is minus and the cosine is plus.



INTERSECTION DIAGRAM

Figure for determining the point of intersection of two lines when the courses and positions are known

If one of the known corners is very near the intersection it may not be known which side of the line it is on: that is, it may not be known whether the line from this corner to intersect with the other line would have to go northeast or southwest, northwest or southeast. In this case assume it to be one or the other. When found, if x is a plus quantity, the assumption is correct. If x comes out minus, the assumption is incorrect and the line runs in the opposite direction.

A practical application of the formula follows:

Given the latitude and longitude of A as 4,194.68 (T_a) and 4,030.58 (G_a) respectively, and those of B as 3,732.75 (T_b) and 4,362.18 (G_b), respectively. The bearing of the line from A toward the intersection (C) is S 73° 41′ E (B_a) and that of the line from B toward C is N 26° 14′ W (B_b).

Then

$(G_a - G_b) = 4030.58 - 4362.18 = -331.60.$
$(T_a - T_b) = 4194.68 - 3732.75 = \ \ 461.93.$
$\sin B_a = +\sin 73° 41' = +0.95972.$
$\cos B_a = -\cos 73° 41' = -0.28095.$
$\sin B_b = -\sin 26° 14' = -0.44203.$
$\cos B_b = +\cos 26° 14' = +0.89700.$

Substituting these values in the formula given above

$$x = \frac{-331.60 \times 0.89700 - 461.93 \times (-0.44203)}{(-0.44203) \times (-0.28095) - 0.95972 \times 0.89700} = 126.59.$$

This last figure is the length of the line from A to C. Having this and the bearing of the line, it is a simple matter to figure the co-ordinate of C and, from these, the length and bearing of the line to C from the nearest traverse point—this last for the purpose of establishing the point C in the field.

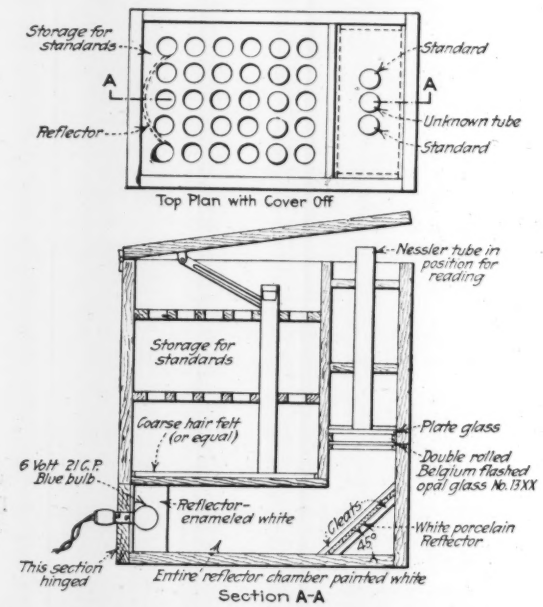
Portable Apparatus for Determining Residual Chlorine and Turbidity

By H. H. Gerstein
Assistant Sanitary Engineer, Division of Water Safety Control, City of Chicago

TO obtain more accurate quantitative determinations of residual chlorine by the ortho-tolidin method in field work, a portable apparatus to be used in the comparison of the color developed by the combination of the residual chlorine in the water and ortho-tolidin solution with color standards has been designed by the writer for the Division of Water Safety Control of the Department of Public Works, Chicago, and has proved to be very useful. The apparatus is also used for the estimation of turbidity in the water by comparison in Nessler tubes with turbidity standards. Its design is shown by the accompanying drawing.

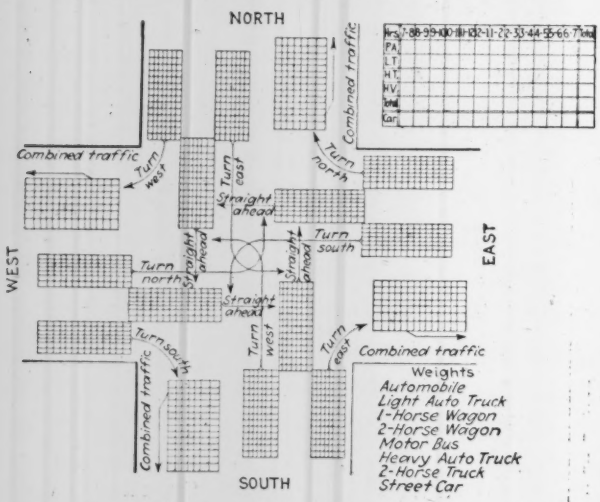
Comparison of the unknown color with the color standard is accomplished by the use of an evenly distributed reflected light comparable to daylight. With the aid of a white enamel reflector, the light from a 6-v., 21-cp. blue automobile headlight bulb is thrown on a tilted polished white porcelain plate, which is set at an angle of 45 deg. with the bottom of the reflector chamber. The porcelain plate reflects the light through a daylight screen. No. 13xx double rolled Belgium flash opal glass is used for this purpose. The screen is protected by a sheet of plate glass fastened directly above it.

A frame holds three Nessler tubes perpendicularly above the plate glass in position for comparison. The method followed in making the comparisons is to place the Nessler tube containing the unknown solution in the center and shift the color standards until the tubes having a color of the next higher or lower intensity than the unknown are found. A storage chamber is provided which will hold a large number of standards, empty Nessler tubes, pipettes and ortho-tolidin solution. The bottom of this chamber is lined with coarse hair felt to protect the Nessler tubes. In field work the electrical current for the apparatus is obtained by plugging an extension to the dash lamp socket of an automobile.



PORTABLE APPARATUS FOR COMPARING UNKNOWN TURBIDITY OR RESIDUAL CHLORINE WITH STANDARDS

Chart for Analyzing Vehicular Traffic



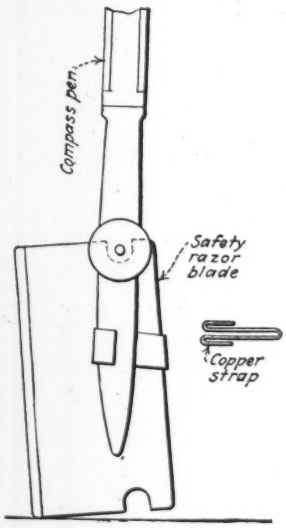
THE chart herewith shown has been used by the City Planning Board of St. Paul, Minn., whose engineer is George H. Herrold, for analyzing traffic at street intersections. From this diagram the total flow of each kind of vehicle by hours in any direction is determined. It is used to determine whether an intersection should be expanded by setting back the curbs or whether the corner should be cut off. It is also used in determining the kind of signal to be used if the traffic volume warrants the introduction of signals for controlling the intersection. Where the total congestion value is desired, the planner has access to figures shown in the upper right-hand corner of the chart where the weights of all classes of vehicles are tabulated.

From Job and Office

HINTS THAT CUT COST AND TIME

Job and Office Notes

In Cutting Out Circular Paper Curves, the compass with the aid of a safety razor blade and a small copper strap, made a neat and true job. A strip of light copper, about ¼ in. x 1 in. was bent in four folds as shown in sketch. This strap is then placed around the two blades of the pen, as shown, the safety razor blade placed in the pen, and, with the thumb screw of the pen, tightened. By

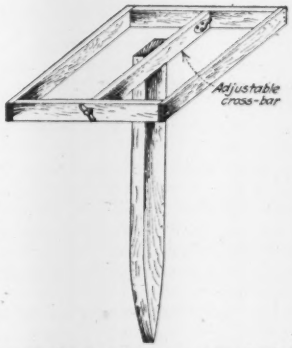


From Job and Office

HINTS THAT CUT COST AND TIME

scribing a circle several times, a clean cut is made, resulting in a true circular curve.—FRANK E. HARLEY, resident engineer, New Jersey Highway Commission.

There Is Pictured Herewith a Rude though Simple, inexpensive and comparatively accurate instrument for running levels which was devised primarily for terracing farm lands in the Piedmont section of North Carolina. It may be copied by engineers wanting some rough level information, but without having instruments at hand. The accuracy of the device would depend on the sensitiveness and accuracy of the carpenter's level, though from actual observation it has been possible, with a target set at 300 ft., to set stakes within 0.3 ft. accuracy. The device is a 2-ft. square wood frame with an adjustable cross-bar. The cross-bar is attached to a stake driven in the ground. This gives means of adjusting the top of the frame to a level frame when using a carpenter's level. The instrument man sights across the top of the frame and the rodman carried a pole with a cross stick nailed on it at the desired distance of the terrace below the line of sight. Stakes are placed at 50- to 100-ft. intervals, depending on local conditions. These are then horizontally adjusted by eye to get a good line for the terrace, and grade stakes are then set on the chosen line of the terrace constructed to that height.—SAMUEL P. BAIRD, Managing Engineer, Cleveland Springs Co., Shelby, N. C.



Constructing Integral Curb in a simple and efficient method has been developed the past season by certain contractors in the Chicago district, says a recent issue of *Concrete Highway Magazine*. In some of the smaller communities in the metropolitan district a low, flat curb has become popular. A typical curb of this sort would have a 2-in. flat top, a base width of 10 or 12 in., and a height of 4 or 5 in., leaving the face with so little batter that no face form is needed. The face is usually given a reverse curve which meets the flat curb top at one end and the pavement crown at the other. This face is secured with a straightedge which rests on strap-iron guides. The back forms are set to the height of the curb. The top of the back form is slotted at 10-ft. intervals. Into these slots is hooked one end of a piece of strap iron which has been bent to the shape of the face of the curb. The other end of the strap iron is driven into the ground, to hold it rigid. Except in the area which the curb will occupy, the pavement is struck off with a hand templet resting on the side forms. Enough concrete to make the curb is deposited against the forms by the mixer or by concrete spreaders where it is left by the strike-off templet. This curb concrete is then struck off with a straightedge whose ends rest on the strap-iron guides. The strap irons are then taken out and the curb is finished with a wooden hand float and brush.

Flood Lighting on a New York City Foundation Job

FOUNDATION contractors in large cities must invariably work against time so as not to delay steel erection; constant night work is a result. The illustration shows the excavation for the new Savoy-Plaza Hotel, New York City, as it looks at night, being done by The Foundation Co.

Lights are placed at about 50-ft. intervals entirely around the site. The reflectors are of a large dish-pan type 48 in. in diam. and hold 1,000-watt bulbs, covered with diffused-light outer globes. Direct current at 220 volts is used. No exact formulas are followed in placing the lighting units, the judgment of the contractor's electrician determining the first layout. Following this, any serious shadows are removed by a shifting of the lights. The site fronts on Fifth Ave. and extends from 58th St. to 59th St.

Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

High Intensity Curve for New York Storm of Aug. 12, 1926

Sir—The storm occurring in New York City on Aug. 12, 1926, is of particular interest to storm sewer designers in view of its somewhat unusual nature. The rainfall occurred in two distinct thunderstorms approximately 30 minutes apart, the first storm thoroughly saturating the ground, while the second had a rapidly rising intensity with a peak 20 minutes after its beginning.

Eastern Parkway; (2) New Jersey Ave. and Jamaica Ave.; (3) Sheffield Ave. and Livonia Ave. The gage at Hull St. went out of commission during the storm but the records at the other two were complete as follows:

RAINFALL IN INCHES DURING HOURLY PERIODS

Eastern Standard Time

	4-5	5-6	6-7	7-8	8-9	9-10	10-11	Total
New Jersey Ave., 4:14 to 9:01 p.m.	1.64	1.40	3.17	0.65	0.13	0.01		7.00
Sheffield Ave., 4:11 to 10:45 p.m.	1.52	1.45	2.62	0.65	0.13	0.02		6.41

HIGHEST INTENSITY FOR STATED PERIODS OF MINUTES, IN INCHES PER HOUR

	5	10	15	30	45	60
New Jersey Ave.	6.60	6.12	5.00	4.06	3.72	3.17
Sheffield Ave.	5.88	4.86	4.08	3.02	3.03	2.69

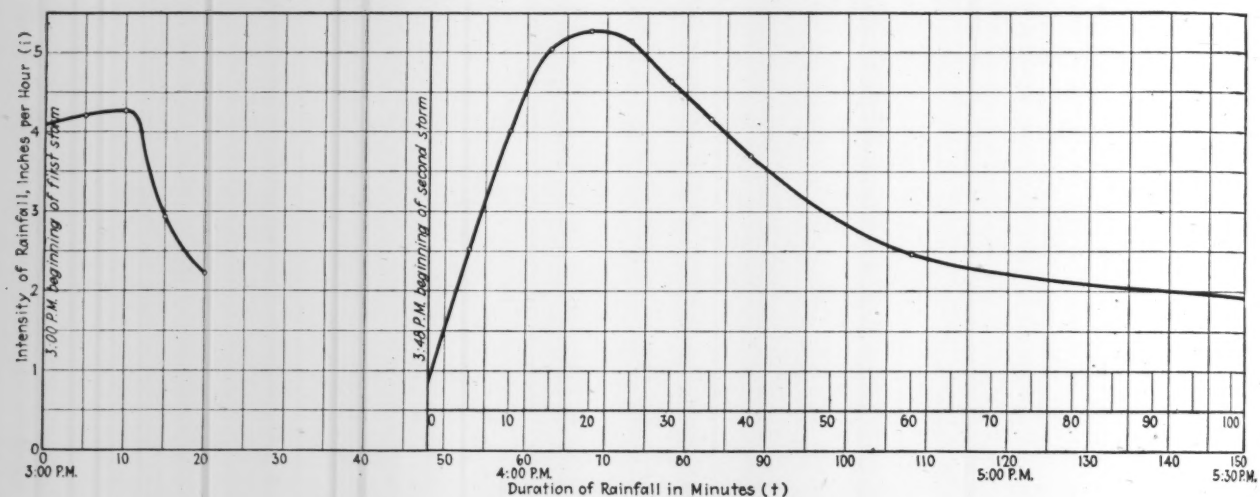
Another record, made at the gage at the Ave. U sewage pumping station near 86th St., close to Coney Island, where the storm extended from 4 : 02 to 11 : 53 p.m., was:

HIGHEST INTENSITY FOR STILLED PERIODS OF MINUTES, IN INCHES PER HOUR

5	10	15	30	45	60
5.88	5.16	3.72	3.60	3.00	2.58

RAINFALL IN INCHES DURING HOURLY PERIODS

4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	Total
0.43	2.56	1.08	trace	0.12	trace	0.04	0.02	4.25


Intensity of Rainfall, Inches per Hour (i)
3:00 P.M. beginning of first storm
3:49 P.M. beginning of second storm
Duration of Rainfall in Minutes (t)
3:00 P.M.
4:00 P.M.
5:00 P.M.
5:30 P.M.

STORM INTENSITY CURVE, NEW YORK CITY, AUG. 12, 1926

From record of U. S. Weather Bureau, Battery Station. Maximum 5-min. precipitation, 0.75 in., 4:00 to 4:05 p.m.

The accompanying intensity curves for these storms show the conditions plainly and indicate that a storm of this type will impose very severe concentrations in storm sewers because the high peak intensity occurred a considerable time after the beginning of the storm, while there was also an unusually high intensity during the latter part of the storm.

Although ordinarily in the design of storm sewers such a storm could well be ignored because of the unwarranted increase in the size of pipe over that required to care for ordinary conditions satisfactorily, the use of this curve may prove of advantage in connection with the design of sewers for special conditions.

The record of accumulated rainfall was very kindly furnished by James H. Scarr, meteorologist, U. S. Weather Bureau, the gage being located at the Battery Station, New York City. The intensity curve was prepared by the writer. [See also *Engineering News-Record*, Aug. 26, p. 357; in the table there, 7/12/26 should have read 8/12/26.]

CHARLES M. NOBLE,
Bridge Department, The Port of New York Authority.

New York City,
Sept. 17, 1926.

Another High Rainfall in New York City

Sir—In your issue of Aug. 26, 1926, p. 357, you presented some notes on "Short Time Rainfall Record in New York City Broken," including some figures for the storm of Aug. 12, 1926, as observed on the gage maintained by the Bureau of Sewers, Brooklyn, at Hull St. near Eastern Parkway.

More intense than any storm previously recorded in Brooklyn was the one that occurred on Sept. 6, 1926. The Brooklyn Bureau of Sewers maintains three rain gages in the East New York Section of Brooklyn, all within the radius of a mile. They are located at (1) Hull St. near

ARTHUR J. GRIFFIN,
Chief Engineer, Bureau of Sewers, Brooklyn Borough.

New York City,
Sept. 27, 1926.

Lightning Query

Sir—Seeing the editorial in your Sept. 16 issue, p. 447, in regard to lightning striking a concrete road reminds me of an incident happening this summer. Our men were laying some cast-iron pipe and four men were handling the pipe. There was a storm in the distance with considerable lightning although where we were working the sun was shining brightly. At every flash of the distant lightning the men handling the wrenches received quite a shock. I have not figured out in my mind just what happened. The trench where the men were working was in very dry clay and there might have been a sort of condenser effect, the men becoming charged and the charge released when they touched the pipe.

But why the synchronism with the distant flash?

SAMUEL P. BAIRD,
Managing Engineer Construction Division, Cleveland Springs Co.

Shelby, N. C.,
Sept. 19, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

San Gabriel Flood Control Dam Project Advanced

Los Angeles Flood Protection Project Scores Another Point in Federal Authorization

The Los Angeles County Flood Control District has received permission from the Secretary of Agriculture to construct a railroad on the national forest lands of the San Gabriel Canyon, northeast of Pasadena, Calif., to be used in the construction of a flood control dam at the Forks site on the San Gabriel River. This permit had been fought by the city of Pasadena on the ground that such a railroad would interfere with a proposed water-supply reservoir it contemplates below the Forks dam. Hearings were held in Washington last summer before the Secretaries of Agriculture and Interior, but both secretaries have granted the County Commission the permits it sought, the Secretary of the Interior for the use of the land and water for the reservoir and the Secretary of Agriculture now for the right-of-way through the valley.

Terms of Permit

The announcement of the Department of Agriculture is as follows:

"The Secretary of Agriculture has approved the plan recommended by the Forest Service under which a permit will be issued immediately to the Flood Control District for building the railroad required in the construction of the county dam at the Two Forks site. The permit will contain special stipulations designed to protect the interests of Pasadena and other municipalities which have pending water appropriations from San Gabriel River and pending applications for storage easements. One of the stipulations gives the Secretary of Agriculture the right to require removal of the railroad to a higher location if it actually interferes with water appropriations or storage rights that may subsequently be acquired by Pasadena, Long Beach, or Whittier, all of which now have applications pending before the state and federal authorities for both water and storage grounds. A removal of the railroad should be conditional upon the payment of an equitable proportion of the cost of reconstruction by the municipality for whose benefit the relocation is made. The permit will also stipulate that, in the event of actual interference by the railroad with municipal storage projects, an agreement on the part of the Flood Control District to store water in its reservoir for the use of the municipality concerned during the period while the use of the railroad is continued may be accepted as satisfactory compliance with the terms of the permit. The railroad is also to be available, at equitable compensation, for the use of public agencies engaged in public works in transporting materials and supplies.

"Secretary Jardine said that it was his desire to reach a solution which would permit the Los Angeles County Flood Control District to proceed without delay in constructing the dam at Two Forks which has been authorized under federal easement, but at the same time to protect any water appropriations and storage rights which Southern California municipalities may acquire in San Gabriel Canyon before the project of the Flood Control District is completed. The form of permit issued should safeguard the interests of Pasadena and the other municipalities.

"The secretary further pointed out that many of the questions raised as to the rights of the respective parties are local issues, determinable only under the state laws and by the state courts—not matters under the jurisdiction of the Department of Agriculture."

Engineering Fifty Years Ago

From *Engineering News*, Oct. 14, 1876

THE stonework on the new bridge which is to span the Monongahela at the "Point," Pittsburgh, was completed about a week ago, Mr. John Megraw, of Allegheny, was the contractor, and the contract amounted to nearly $200,000. The most of our readers are probably aware that the American Bridge Co., of Chicago, are erecting the superstructure, which is of iron. A large portion of the iron work is done in Pittsburgh.

Quebec and Ontario Settle Boundary Power Problem

The provinces of Ontario and Quebec have entered into an agreement under which they will have equal rights of all power developed on the Ottawa River which forms the provincial boundary. The development of the National Hydro-Electric Co. Ltd. at Carrillon Falls will be considerably extended and the rights of Ontario and Quebec to the Falls have been leased to the company for a term of 60 years. The company agrees to start development work by Dec. 1, 1927, and have 100,000 hp. developed before 1932. Ontario is to receive one-half of the power produced, an annual rent of $10,000 and a royalty of 60 cents per horsepower. Not more than one-half of the power received by Ontario is to be exported. The agreement arrived at between the provinces is regarded as of great importance in view of future development on the Ottawa River, the power capacity of which is estimated at 750,000 hp.

Hurricane Damage at Pensacola, Fla.

L. & N. R.R. Heaviest Sufferer—Wind and Tide Wreck Trusses of Rolling Lift Bridge

(Special Correspondence)

The hurricane which brought new wind velocity and tide height records to Florida reached Pensacola and vicinity on Sept. 20. The winds came first from the north, thence around to the east, and finally from the southeast. The storm center is reported to have passed approximately 25 miles west of Pensacola and its path was about 65 miles in width. The maximum wind velocity over a 5 min. period is officially reported as 116 miles per hour. The Weather Bureau reports an extreme velocity of 152 miles per hour over a period of four-tenths of a minute. The tide at the mouth of Pensacola Bay seems to have been approximately 11½ ft. above mean low water. Greater heights obtained at the headwaters of bayous where the wind piled up the water. The highest previously recorded had been 10.8 ft.

Structural damage was largely confined to waterfront properties, and roof damage. The Louisville & Nashville R.R. lost heavily on their waterfront trackage, their wharves, their ship coaling pier and on their 3-mile trestle over Escambia Bay, east of Pensacola. Other wharves and waterfront property, notably those of large fisheries, were badly wrecked. All were wooden structures.

Considerable damage was done at the Naval Air Station but it is understood that this is being reported officially from there.

Rolling Lift Bridge Fails

A heavy rainfall with the retarding effect of the high tide at the mouth of Escambia and Perdido Rivers, caused new record heights on these streams. Some $15,000 damage to paved highways was caused by washing out fills. A rolling lift bridge over Bayou "Chico" was overturned by the force of the wind after the surging tide had raised the floor system high enough for the wind to strike it. The trusses were wrecked, but the foundations seem intact.

The $1,500,000 highway bridge over Escambia Bridge on State Road No. 1 East of Pensacola, just completed in July of this year, came through with no damage to the bridge proper, or the trestle work. Approximately $50,000 damage was done to the 2.3 miles of fill included in that structure, of 3.2 miles total length. Sodding of slopes had not been completed.

The wharves at Fort Barrancas and Fort Pickens at the mouth of Pensacola Bay were demolished. The cost

(Continued on p. 641)

Employees of Edge Moor Form Veterans Club

Twenty-four former and present employees of the Edge Moor Iron Co. met at dinner in Philadelphia on the evening of Oct. 8th, and organized the "Edge Moor Veterans," with George H. Pegram as president and Miss Helen Garrett as secretary. The following list of those present is arranged in the order of the beginning of their service.

J. Allen Colby, F. H. Brinton and Henry C. Downward	1874
A. E. Rossiter	1875
Julius Hess and William F. Sellers	1876
Robert A. Shaller	1877
Alba B. Johnson, J. Watson Philips and John McLeod	1878
Warren M. Osborne	1879
George H. Pegram, Reginald P. Bolton, William H. Smith, George T. Hardy and G. D. Hardy	1880
Frank R. Pegram	1881
Henry B. Seaman	1883
Charles W. Bryan and D. Clinton Davis	1184
Miss Helen Garrett and Otis E. Hovey	1886
S. P. Mitchell	1887
C. G. E. Larsson	1888

Mr. Sellers and Miss Garrett are now connected with the present Edge Moor Iron Co. as president and secretary, respectively. A few of the others have retired and the remainder are engaged in various engineering and business enterprises. Several prominent engineers could not be present, among them Onward Bates, Charles F. Loweth and John E. Greiner.

The Edge Moor Iron Co. was organized in 1868 by the late William Sellers for the manufacture of bridges and other iron structures. The late C. Shaler Smith was retained as consulting engineer, and the company at once took a leading position as a designer and builder of bridges. Among the large and well-known bridges built early in the history of the company may be mentioned the Kentucky River High Bridge, the first cantilever bridge in America, the Royal Gorge Bridge, the structural parts of the Brooklyn Bridge; also the Sixth Ave elevated railway in New York City.

The company devoted much attention to the design and manufacture of eyebars and took a leading part in the development of methods assuring a reliable product at a reasonable cost.

During 1888, the company was reorganized, the Edge Moor Bridge Works taking over the bridge and structural business and the Edge Moor Iron Co. continued the manufacture of boilers and similar products. During 1900, the Edge Moor Bridge Works became a part of the American Bridge Co.

Elisha Lee To Hold New Position on Pennsylvania Railroad

Elisha Lee, vice-president in charge of operation, Pennsylvania Railroad, has been appointed to a newly created position of vice-president in which he will assist the president in the supervision of the general business of the company. Mr. Lee began his service with the Pennsylvania as a rodman in 1892, and has been successively assistant supervisor and supervisor, assistant engineer maintenance-of-way, principal assistant engineer on the Philadelphia, Baltimore & Washington, superintendent of the New York, Philadelphia & Norfolk Railroad, also a subsidiary of the Pennsylvania, and then assistant to the general manager of Pennsylvania lines east of Pittsburgh. In 1914 he was appointed general superintendent of the Philadelphia, Baltimore and Washington Railroad and in 1916 became assistant general manager of the system. Early in 1917 he was promoted to be general manager, and in the latter part of the year was delegated to take over the duties previously administered by W. W. Atterbury while he was in the military service. During federal control, he was federal manager of the Pennsylvania lines east. In 1923 he was appointed vice-president of the Central Region.

At the time of Mr. Lee's promotion the company made a number of other promotions which include a notable number of men who began service with the Pennsylvania in engineering departments. R. V. Massey, general manager of the Eastern Region, has been named to a new position of assistant to the vice-president in charge of personnel. Mr. Massey is a graduate of Sheffield Scientific School, class of 1892, and began work with the Pennsylvania as a rodman in the construction department. C. I. Leiper, assistant general manager of the Eastern Region, has been appointed to a newly created position of general manager of the Central Region with headquarters at Pittsburgh. Mr. Leiper entered the Pennsylvania engineering department in 1897, subsequently becoming a supervisor and later a division engineer. H. E. Newcomet, general superintendent, Lake Division, has been appointed to the newly created position of general manager of the Western Region with headquarters at Chicago. He also began service with the Pennsylvania in the engineering department as did J. H. Redding, superintendent of the Pittsburgh Division, now appointed to be general superintendent of the Western Pennsylvania Division, and G. W. Curtis, the present assistant superintendent of the Pittsburgh Division, who has been appointed superintendent of the Norfolk Division.

I. W. Geer, assistant general manager of the Western Region, has become assistant chief engineer with headquarters at Chicago.

Florida Engineers Begin Storm Study

A study of the technical features of the Sept. 18 hurricane in southern Florida has been begun by the Dade County Engineers' Association and the Palm Beach Engineers Association in co-operation. Separate committees will deal with waterfront structures and effects, structural questions, underground constructions (especially those involving sanitary service), and drainage problems, including those of the Everglades district. C. H. Garis, of Watson & Garis, Miami, and Karl Riddle, of the Riddle Engineering Co., West Palm Beach, are in general charge of the work as presidents of the two associations.

Dredging Contract of $800,000 for Deeper Hudson Authorized

Secretary of War Davis on Oct. 7 authorized the United States District Engineer at New York to advertise for bids on the first two Deeper Hudson dredging contracts. The year's allotment of $800,000, first to be assigned from the government appropriation of $11,200,000, has been turned over to the army board of engineers by the war department. The following statement was issued by the war department in approving the first allotment of funds:

"The old project for the Hudson River provided a 12-ft. depth in the upper river. The rivers and harbors act of March 4, 1925, provided for a channel of 27 ft. deep from the city of Hudson to the Albany Greenbush bridge in Albany.

"Expenditures under this project were contingent upon certain local cooperation. Among the requirements imposed on local interests were: 1, Provision of dumping ground for dredged material; 2, organization of a terminal agency with the special view of promoting transfer of freight between ships and rail terminals; 3, provisions satisfactory to both the Chief of Engineers and the Secretary of War for the construction of certain terminals in the Port of Albany.

"While these requirements have not yet been fully met, negotiations have progressed to such a point that in the opinion of the Chief of Engineers they will probably be completed within a few days.

In order that work may be advertised and operations begin promptly after formal compliance with the conditions imposed, the Secretary of War has approved an allotment of $800,000 to be applied to the improvement of the Hudson River.

Government Barge Line Reports Increasing Business

In a report to the Secretary of War on the operation of the government owned Mississippi-Warrior service, the chairman of the Inland Waterways Corporation estimates that the barge line will handle a total tonnage of 1,353,146 tons in 1926 and will show a net income of $347,632. These figures include depreciation upon the equipment, but do not include any maintenance charges upon the waterways used by the Inland Waterways Corporation for its barge lines. Figures for 1926 are based on actual figures for eight months and an estimated figure for the remaining four months.

The report made by General Ashburn shows an encouraging increase in freight handled from 979,772 tons in 1923 to 1,353,146 in 1926. It shows a still more encouraging increase in average revenue per ton of 89c. over the 1923 figure. This is due largely to the increase in packet freight carried and to some extent to better division of accruing revenues from rail-water hauls. At the same time the overhead expenses decreased 2c. per ton on both lines.

New Duluth-Superior Toll Bridge

Improved highway communication between the cities of Duluth, Minn., and Superior, Wis., on opposite sides of St. Louis Bay, will be provided by the new bridge now being built for the Arrowhead Bridge Co., Superior, Wis. Traffic between these two cities is now served mainly by the Interstate Bridge, owned by a subsidiary of the Great Northern Ry. Co., and having a swing span for both railway and highway traffic. This structure, built thirty years ago, crosses the harbor at a point where the shipping traffic is congested, so that the swing span is required to open frequently, with consequent delay to vehicle traffic. In November, 1924, one of the fixed spans of this old bridge was knocked down by a steamer and the bridge was out of commission for about two months, vehicle traffic having to take a route of about 23 miles by way of Oliver, Wis.

As the need for a new bridge became apparent, local parties organized the Arrowhead Bridge Co. and secured a franchise from the U. S. Government for a bridge from LaSeur St. in West Duluth to Belknap St. in Superior. The company endeavored to get the states of Minnesota and Wisconsin to construct the bridge, but without success, and the work is now being carried forward as a private toll bridge enterprise. This bridge, with approaches, will be about 3,000 ft. in length, of which 2,000 ft. will be of timber pile construction having a 24 ft. roadway with bitulithic paving.

The movable span will be a double-leaf deck bascule of the Scherzer rolling-lift type, giving a clear channel width of 227 ft. The span between end bearings is 240 ft. and the overall length of the structure is 294 ft. It provides a 24-ft. roadway and one 4 ft. sidewalk. This structure is designed to meet the specifications of the Minnesota State Highway Department. The machinery and operating equipment are designed to operate the structure against a 10-pound wind. Two 25-hp. motors are provided for each leaf and are capable of operating the structure in 1½ minutes against the maximum resistance. In case of failure of the main current supply, there is a generating unit consisting of a 75-hp. gasoline engine directly connected to a generator. This emergency equipment will open the bridge against normal resistances in the specified time of 1½ minutes. By means of additional gear reduction it will open the bridge against the maximum resistance in about six minutes.

The contracts call for the completion of the project by March 15, 1927. The engineers for the owners are Roland C. Buck, Inc., Superior, Wis. Peppard & Fulton, Minneapolis, are the general contractors for the entire bridge, and the American Bridge Co. will fabricate the structural steel and machinery. The Scherzer Rolling-Lift Bridge Co., Chicago, designed the movable span and will have general supervision over its erection.

New Water Supply for Providence Put in Use Sept. 30

The new water supply system for Providence, R. I., was officially put in use on Sept. 30. It includes an impounding reservoir on the Scituate River, a mechanical filtration plant and a supply conduit. A new service reservoir is to be built. Frank E. Winsor was chief engineer of the project and now assumes a like position on the proposed additional water supply for the Boston Metropolitan District.

Pensacola Hurricane Damage

(*Continued from p. 630*)

of replacement will probably be about $20,000.

The principal inconvenience to the people of Pensacola was caused by stoppage of telephone and electric service, overhead lines being practically demolished. Water service was stopped, also, by the breaking off of large mains at the piers on the waterfront, this draining practically the whole system before the trouble was discovered and corrected.

Pensacola, proper was helped by her topography, nearly all of the residential section being far above the storm tide. No damage is evident on any of the large office buildings. Telephone and electric light poles were blown down and huge trees uprooted but in spite of this there were but few accidents and no loss of life.

New Tunnel Driving Record Set

According to advices from J. E. Barber, vice-president of A. Guthrie & Co., Inc., a new record for drifting on the Cascade tunnel for the Great Northern Ry. was established during the month of September. A record of the August drifting was contained in *Engineering News-Record*, Oct. 7, p. 594. The September record, which included the first day in October, in order to make a 31-day period, comparable with other periods during which records have been taken, showed that A. Guthrie & Co. progressed 984 ft. in the center heading, being driven west from the east portal at Berne.

This heading is 10x10 ft. in cross-section through altered granite and was worked only on one face.

Mississippi Waterway Meeting to Be Held Nov. 22, 23

At the annual meeting of the Mississippi Valley Association, to be held at St. Louis on Nov. 22 and 23, consideration will be given to the program for completion by the U. S. Government of waterway projects in the Mississippi River valley within five years. This program includes the Mississippi, Ohio and Missouri rivers, and a 9-ft. channel for 223 miles of the Illinois River to connect with the proposed Illinois waterway from Chicago to the Illinois River. There will be discussion also of the River and Harbor bill, which is expected to be taken up by Congress in December.

State Engineering Examiners to Meet at Philadelphia

The National Council of State Boards of Engineering Examiners announces Philadelphia as the place and Nov. 15 and 16 as the time of its seventh annual convention; the meeting will be held in the Adelphia Hotel.

A model registration law for professional engineers will be one of the main topics for discussion; in addition to that there will be, besides a general round-table discussion, consideration of the article on reciprocal agreement and of changes in the council's constitution in the section on membership.

ROLLING LIFT BRIDGE AT PENSACOLA DESTROYED BY TIDE AND WIND

Sanitarians of Lower Lake Michigan Meet

Third Annual Congress at Racine, Wis., Holds Three-Session Program With 25 Speakers

For the third year officials and sanitarians interested in eliminating sawage from Lake Michigan held a two-day meeting as the Lake Michigan Sanitation Congress, with about 100 present. The idea of the congress, which was held Sept. 24 and 25 at Racine, Wis., is mainly one of an exchange of information between officials and those working on the water and sewage problems of the lake cities in Wisconsin, Illinois, Indiana and Michigan. A three-session program loaded with 25 speakers was followed by an inspection of the Milwaukee sewage-works. Among the points brought out were: That analyses show that a safe lake water cannot be obtained nearer than from seven to eleven miles out, that filtration is coming for Chicago ($100,000 having been appropriated for experiments), that filters alone without elimination from the lake of the sewage from the cities in northern Indiana will not produce a satisfactory water free from phenol tastes, that these Indiana towns are close to the formation of a sanitary district, that analyses of 33,000 samples of water taken in three years show that Waukegan distributes the least safe water of any city from Waukegan to Gary (because of insufficient chlorine) and that Racine has a filter ready for operation within two months time.

Industrial Wastes

C. M. Baker, state sanitary engineer, Wisconsin, read a most informing paper on "The Relation of Industrial Waste to Sewage Treatment" and referred specifically to the co-operative work between paper mill and canning industries and the State Board of Health in working out solutions of the waste problems. Recovery of $28,000 worth of wood fiber annually at a 50-ton sulphite mill cost $15,000 for installation and removes the equivalent of the sewage of 150,000 people. Along this line Langdon Pearse, sanitary engineer, Sanitary District of Chicago, reported that the Corn Products Co., at Argo, was arranging to recover its losses, saving 2,000 bu. of corn and reducing the equivalent pollution from 360,000 people to 38,500 and ultimately somewhere below 10,000.

W. W. DeBerard, chief engineer, Chicago Regional Planning Association, indicated that water and sewage disposal facilities were fundamental in regional development. Water from Lake Michigan pumped through large conduits, he said, was the logical supply for the area west of Chicago to the Fox River valley because the ground-water levels are receding at an alarming rate, 8 to 12 ft. annually. The Regional Planning Association proposes to help initiate and co-ordinate the plans and activities of the various political jurisdictions involved rather than produce elaborate plans of its own.

H. P. Ramey, assistant chief engineer, Sanitary District of Chicago, outlined the present status of the district's program to meet the requirements of the War Department in accordance with the provisions of the grant of 8,500 sec.ft. of diversion water from Lake Michigan. More than $45,000,000 has been spent on sewage disposal and the program absorbs about $12,000,000 annually. The North Side activated-sludge plant to care for 800,000 people (the largest plant of the kind in the world) is 75 per cent complete, and cost $21,000,000. The West Side plant, for 1,600,000 people, has been started. Bids for the pumps have been taken and bids for the first battery of the Imhoff tanks were to be taken Oct. 7. At least one-third of the plant must be completed by 1928.

T. Chalkeley Hatton, chief engineer, Milwaukee Sewerage Commission, stated that the activated-sludge plant of that city is treating 45 m.g.d. (one-half the flow), the sludge being filtered, dried and sold at an average net return of $13.48 per ton equivalent to $16.85 p.m.g. of sewage. Air required is 1.28 cu.ft. per gal. for aeration and 0.16 cu.ft. more for agitation in the conduits. Of the shipments 70 per cent go to fertilizer companies, 20 per cent to golf courses and 10 per cent for city lawns. Sale of sludge is the least of his trouble, Mr. Hatton stated. All that Indianapolis and Chicago can produce will find ready market. The conveyor troubles have been solved. Apparatus to wash out odors from the dryer gases, a condition causing complaint, will soon be installed. It has been determined that the odors come from finely divided solids rather than from the gases.

All officers of the Congress were re-elected, with H. W. Lee, president, and J. A. Hendricks, Hammond, Ind., secretary.

Test Dam on Stevenson Creek Withstands Head of 60 Ft.

The test dam built on Stevenson Creek east of Fresno, Calif. under the auspices of Engineering Foundation has been filled to overflowing at its present height of 60 ft. without showing any indication of failure. The arch is 7½ ft. thick at the bottom and tapers to a thickness of 2 ft. thirty feet above the base and from this level upward the thickness is constant. Data on the design and the methods of testing this dam were published in *Engineering News-Record*, March 25, p. 494.

The pouring of concrete in the dam was completed June 4; a month later tests were begun and were continued intermittently until maximum loading for the 60-ft. head was reached late in September. Under heads less than 50 ft. there was no leakage through the concrete, with water at the 50-ft. level a small patch of moisture appeared at a construction joint 15 ft. above the base of the dam and under a 60-ft. head the moist area increased to about 7 ft. square. There was also some leakage around abutments. The dam contains no reinforcing steel nor was any special provision made in the concrete to make it waterproof.

It is hoped that funds may be secured with which to extend the height of the dam to 100 ft.

WASHINGTON NOTES

IN A report to the Federal Power Commission the Chief of Engineers has recommended the issuance of a license to the Carolina Light and Power Co. covering its project on the Big Pigeon River in Haywood County, N. C. This company formerly was the Pigeon River Power Co. It has applied for a license in compliance with the terms of its preliminary permit. It proposes to build a dam 150 ft. high and to install equipment sufficient to generate 60,000 hp. The primary capacity of the project is 13,500 hp.

The action of the Federal Power Commission in granting a license to the Best Flume and Power Co. on Pine Creek at Pinedale, Wyo., has given rise to hope among those interested in other projects on the remote tributaries of the Colorado. Pine Creek is an upper tributary of Green River.

The commission last year adopted a resolution declaring its intention to take no action on projects in the Colorado River Valley. The idea was to give the states in the basin a further opportunity to work out an agreement as to the use of the waters of the Colorado and its tributaries. A number of projects and contemplated developments which have no direct bearing on the Colorado River controversy feel that they should not come within the scope of the resolution. It seems probable that the commission will consider separately any such project.

A CHANGE in the plans for the power project near Bagnell, Mo., on the Osage River, so that the full regulation of the river may be secured, seems probable. This will necessitate a material extension of the reservoir.

The construction plant has been assembled and the excavation for the foundation of the dam has been completed. The uncertainty as to the extension of the reservoir has resulted in some delay in construction as under the changed plans a heavier foundation will have to be provided.

The licensee of the project is Walter Cravens, of Kansas City.

A STUDY of economic conditions in the Columbia Basin is to be based upon five tracts of land, each containing 6,000 acres. It originally had been the plan to select three tracts of 10,000 acres so located as to give typical information as to the Columbia Basin project. After a conference between the directors of the Columbia Basin League and George C. Kreutzer, the Director of Economics for the Bureau of Reclamation, it was decided that a better cross section could be obtained from five tracts. Mr. Kreutzer and several of the directors made an extended trip of inspection and have tentatively selected tracts at Mae, west of Cunningham, at Othello, at Glade, and at Walker.

If funds are sufficient a study may be made of a sixth tract, south of Quincy.

CIVIL SERVICE EXAMINATIONS
United States

For the following civil service examinations apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission.

Hydro-electric engineer, associate hydro-electric engineer, and assistant hydro-electric engineer — Vacancies in the engineer department at large, Chattanooga, Tenn., at respective entrance salaries of $3,900, $3,300, and $3,000. The hydro-electric engineer, under the military officer in charge, will be responsible for the complete investigation of a proposed hydro-electric project, from initial determination of stream flow through the theoretical design of the plant and the transmission lines, the selection of equipment, to the final estimate of the cost of the complete plant. He will supervise the work of subordinates, exercise independent engineering judgment and perform related work. The associate and assistant will assemble data and prepare charts, graphs, maps, calculations and interpretations. Competitors will not be required to report at any place for examination but will be rated on education, training, experience and fitness and upon any writings.

Applications must be on file at Washington, D. C., not later than Oct. 26.

Junior Engineer—Vacancies in various branches of the government service, in architectural, chemical, civil, electrical, mechanical and mining engineering, salary range beginning at $1,860 a year with the usual promotions.

Date for close of filing application, for receipt at Washington, D. C., is Oct. 23.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Pinehurst, N. C., Nov. 8-12, 1926.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

FIFTH ANNUAL ASPHALT PAVING CONFERENCE, AUSPICES ASPHALT ASSOCIATION, New York City, Washington, D. C., Nov. 8-12, 1926.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, Columbia, S. C.; Annual Convention, Philadelphia, Pa., Nov. 15-16, 1926.

HIGHWAY RESEARCH BOARD, OF NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Dec. 2 and 3, 1926.

The Association of State Highway Officials of the North Atlantic States will hold its third annual convention Feb. 16 to 18, 1927, at Atlantic City, N. J.

The Providence, R. I., Engineering Society's inspection trip to the Scituate reservoir and purification works will take place October 16, and on Oct. 19 Allen Hazen, of New York, consulting engineer for the Providence Water Supply Board on Purification Works, will present to the society in detail a description of the city's extensive new water plant.

Personal Notes

CHARLES S. CHURCHILL, formerly vice-president of the Norfolk & Western Ry. and a past president of the American Railway Engineering Association, has opened an office at Roanoke, Va., for general practice as a consulting engineer.

H. C. DOREMUS formerly instructor in the engineering school of the Texas Agricultural and Mechanical College, has been selected as head of the school of engineering, a newly created department, at the John Tarleton Agricultural College at Stephensville, Texas.

FRANK VILERT, Melbourne, Australia, recently of the Reinforced Concrete & Monier Pipe Construction Co., Ltd., announces that he has commenced practice as a consulting and architectural engineer specializing in the design of structures of reinforced concrete and structural steel; his office is in Temple Court, Melbourne.

MAJOR F. J. WHEELER, staff engineer with Col. Gilbert A. Youngberg in the U. S. District Engineer's office at Jacksonville, Florida, has been given a year's leave of absence, effective March 5, to engage in private practice with Major J. M. Braxton, formerly assistant U. S. district engineer. Major Wheeler will go to Sarasota, Florida, as engineer in immediate charge of the harbor project financed by that city. Major Wheeler was in charge of construction at Camp Johnston during the War, and later in the Jacksonville district made a survey on which the War Department will base its action on applications of a private company to build six power dams on the Suwanee and St. Marys Rivers.

PERRY O. CRAWFORD, formerly chief engineer of the California-Oregon Power Co., Medford, Ore., has been made vice-president and general manager of that company succeeding Paul B. McKee, resigned. Mr. Crawford is a graduate of Stanford University, was for three years construction engineer with the Northern California Power Co., for three years in Afghanistan on government hydro-electric work and since 1916 has been with the California-Oregon Power Co.

GILBERT A. YOUNGBERG, formerly a lieutenant-colonel, Corps of Engineers, and U. S. district engineer for the state of Florida, has established joint offices with J. M. Braxton in the St. James Building at Jacksonville for consulting engineering practice. Mr. Youngberg retired from the Corps of Engineers last spring, as noted in *Engineering News-Record*, March 25, 1926, p. 505. Subsequently he was affiliated with the Davis Island organization at Tampa in the capacity of chief engineer, until executive management of the organization was taken over by Stone & Webster. Mr. Youngberg has recently been serving as chief engineer of the Daytona-New Smyrna inlet district.

THOMAS C. HIGGINS has resigned as senior inspector for the Penssylvania State Highway Department and is now connected with the Duquesne Light Co., of Pittsburgh, Pa.

E. M. BLAND, general manager of the Nigerian Railway Co., has arrived in Canada for a tour of the Dominion. Mr. Bland is a Canadian and has been absent from his native country for twenty-six years.

Obituary

D'ARCY SCOTT, former chief commissioner of the Board of Railroad Communeries of Canada died at Ottawa Oct. 1.

CHARLES A. JUDSON, of Sandusky, Ohio, consulting civil and sanitary engineer, and his wife were instantly killed Sept. 30 when their automobile was struck and wrecked by an Erie R.R. freight train on the Belvidere Crossing near Friendship, New York. Mr. Judson was born on a farm near Florence, Erie County, Ohio, 70 years ago. He was educated at Oberlin College. He began his active career as a deputy surveyor in 1882. Later he was city engineer of Sandusky and at the same time superintendent of the waterworks. While maintaining a private office as a civil engineer in Sandusky, he served as collector of customs and as a member of the state senate for two terms. He had charge of the engineering work of what is now the Lake Shore Electric between Sandusky and Lorain and between Norwalk and Ceylon Junction. At the time of his death Mr. Judson maintained his private civil engineering office and was serving as a city commissioner in Sandusky.

THOMAS WILLIAMS BALDWIN, engineer, died recently at his home in Hardwick, Mass. Mr. Baldwin was born in Bangor, Me., in 1849, and received his education at Exeter, Harvard and the Massachusetts Institute of Technology. After graduating from the latter school as a civil engineer, he entered upon a railroad career. For two years he was with the European & North American R.R., and later did much surveying work for the Bangor &. Piscataquis R.R. in Maine. Mr Baldwin next established a business of his own as a civil engineer at Bangor, Me. He later became city engineer at Bangor and for a time was superintendent of sewers. In 1908 Mr. Baldwin went to Massachusetts. He was for a time a member of the Massachusetts Civil Service Commission, and later held a responsible position with the state highway commission. He resigned from the latter position in 1914.

Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Asphalt Association Program

The Asphalt Association has announced the tentative program for its fifth annual asphalt paving conference to be held in Washington, November 8-12, 1926. Among the subjects to be discussed are: Adaptation of So-Called City Pavements to Country Highways; Causes of Success and Failure of Bituminous Macadam Pavement; Asphalt Macadam Mixing Methods; Development of Asphalt Paving Types in South Park, Chicago; Cold Application and Cold Patch for Surface Treatment; Construction of Granite Block Pavement with Asphalt Filler. The afternoon session on Wednesday will be given over to the subject of paving research under the auspices of the Association of Asphalt Technologists, and the Thursday morning session will be a joint session with the American Society for Municipal Improvements with the following subjects: Construction Details Essential to Effective Hot-mix Pavement; Black Base and Its Place in Standard Specifications; Economics of Salvaging Old Pavements. The contractors' session will be held on Thursday afternoon with two subjects scheduled for discussion: Should Paving Contractors be Licensed, and Cost of Incompetent Inspection to Contractor and Owner. This program is subject to changes and additions before the meeting takes place.

Sand and Gravel Convention to be in January

The 11th annual convention of the National Sand & Gravel Association, Inc., will be held in the Gibson Hotel, Cincinnati, Ohio, Jan. 17, 18 and 19, 1927. All producers are invited to attend whether or not they are members. For the first time, exhibits of equipment and machinery will be permitted. Fred E. Hall is chairman of the convention committee with offices at the association's headquarters in Washington.

Boston to Purchase Sixty Trucks for Snow Removal

The city of Boston recently signed an award of four contracts for the purchase of 60 trucks each of 7 ton capacity. The order for the 60 trucks is divided among four companies as follows: Mack Co. 20 trucks; White Co. 20 trucks; American La France Co. 10 trucks; and the General Motors Co. 10 trucks. The purchase of the trucks was brought about largely by experiences during the storms of last winter when the regular equipment relied upon by the municipality for years was unable to cope with the heavy snowfall. According to a notice in the *Boston Transcript*, the average market price to the trade for the trucks now under contract is $7,301 per unit, while the average price to the city was $5,937 per unit.

The trucks were purchased after recommendation of a committee appointed by the mayor and aided by C. E. Stewart, consulting engineer and Dean A. Fales, head of the automotive department of the Massachusetts Institute of Technology.

The board found that in deliveries and service, it would be a better proposition to have the four companies participate in furnishing the trucks. The specifications given to the bidders required that the trucks be completely manufactured by the company and not a fabricated product.

What Do Contractors Think of the Trade-in Situation?

The article published in these pages Sept. 30 gave in rather definite terms the manufacturers' ideas on the practice of turning in used construction equipment to cover a part of the purchase price on a new unit. Manufacturers reluctantly make such trade-ins since they invariably lose money on them. Distributors, in a lesser degree, find fault with the practice. The plan, which a number of manufacturers apparently follow, of definitely refusing to take any used equipment may be the only solution for the manufacturer. But what about the contractor who needs new equipment and cannot afford to scrap a machine which still may have several seasons of use in it?

A letter from a large manufacturer of pumps and other machinery justly criticises the article on the ground that it makes no definite recommendations in regard to trade-in practices. On the other hand any recommendations based only on the manufacturers' viewpoints would be open to doubt as to providing the best solution for the construction industry as a whole. The letters upon which the article were based indicated that this fact is recognized by a majority of the manufacturers. However, the fact remains that there should be some agency, be it manufacturer, distributor, or special used-equipment dealer, that will buy, repair and sell used construction equipment.

What do the contractors think about present trade-in practices? What are their experiences with them? What suggestions have they for better handling the disposal of used equipment? What agency will best serve the contractor who wants to buy used equipment? Airing both sides of the trade-in question should be a healthy thing for the industry.

"We Should Not Be Asked to Trade-In Old Equipment"

(From a Manufacturer of Pumps, Compressors and other Construction Equipment)

Sir: With reference to your article on the trading-in of used equipment published Sept. 30, 1926, p. 560, we recognize that your survey covers a good deal larger line of equipment than that included in our product and that there may be good and sufficient reasons for builders of other types of contractors' equipment to consider the matter of allowance for used equipment. Our company, however, has not and will not accept the return of used equipment in any way affecting the price of new equipment. We have had occasions where we have lost business because we have flatly declined to consider the return of old equipment even though it was of our own manufacture.

We therefore feel that from our individual standpoint that your article simply leaves the entire matter up in the air without any answer or without any definite recommendation looking toward a solution of the question of what should be done with used equipment when the owner wishes to trade it in against new purchases. We cannot afford to take used equipment into the shop and attempt to rebuild it because of the cost and the assumption of responsibility for making the used equipment first-class again.

We are compelled in our own business to depreciate our tools and machinery, and we believe this should be the same rule in the contracting world and that we should not be asked to trade-in old equipment. This is so definite a rule with us that we have little or no trouble with it, and where cases come up we inform the customer courteously but definitely that we will not accept any old equipment in part pay for new, nor will we make any allowance on same. It is up to him if he has not depreciated it to a point where he can afford to scrap it, to sell it wherever and however he can best do so.

This leaves aside all questions of obsolescence or condition of equipment or its availability for present market, which will invariably prove stumbling blocks for those who consider the return of equipment in part pay for new equipment.

We do not consider the automobile business at all analogous, because there is a market for every automobile that will run on the part of some one who wishes to provide himself with such a luxury. In the case of our own equipment we are selling downright necessities and the market is therefore limited. On the other hand there apparently is no limit to the automobile market.

Oil Well Reaches Depth of 8,000 Feet

What is said to be a new world's record in oil well drilling has been accomplished by the Chanslor-Canfield-Midway Oil Co. in Orange County, Calif. Drilling has been continuous on this well, Olinda 96, since March 13, 1925, with a 5¾ in. bit which has now reached a depth somewhat greater than

8,000 ft. A former record depth was obtained by the Peoples Natural Gas Co. on a well on the Lincoln Highway near Pittsburgh on which work ceased at a depth of 7,756 ft. On this new well the shaft has veered from the vertical, drifting about 560 ft. away from the center at about a 6,000-ft. depth. Some drifting back has occurred so that the bottom of the well is now about 28 degrees off. No surveys were possible below 7,000-ft due to the excessive heat. The equipment used in drilling the well is a Westinghouse drilling motor with control, the motor being 100 hp., 440 volt, three phase, 50 cycle with a speed of 585 r.p.m. There are also three 75 kva., single phase transformers stepping the current from 16,500 volts to 460 volts.

Business Notes

MUNDY SALES CORP., New York City, announces the appointment of Ole Olsen, New Orleans, as exclusive distributor for its hoisting equipment in Louisiana. F. W. Gartner Co., Houston, Tex., has also been appointed for southern Texas.

R. C. BROWER has recently been appointed general manager of Timken Roller Bearing Service and Sales Co., which maintains 25 direct factory branches and several hundred authorized distributors. Mr. Brower will make his headquarters in Canton, Ohio, at the plant of the Timken Roller Bearing Co.

CEMENT SHIPMENTS contributed 7,490,323 tons to the revenue freight carried by Class 1 railroads during the second quarter of 1926, figures just released by the Interstate Commerce Commission show. Brick and artificial stone contributed 5,850,360 tons, while asphalt to the extent of 827,373 tons was shipped.

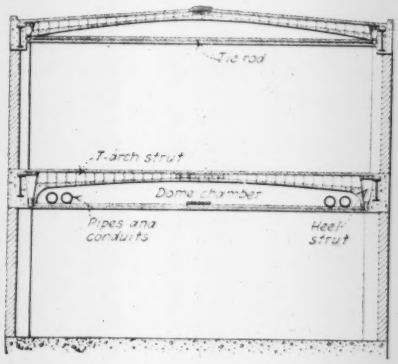
PULASKI FOUNDRY & MFG. CO., Cleveland, Ohio, has formed a new company to be known as the Pulaski Engineering Works, Inc., which it is said will provide a complete service in design, fabrication, manufacture and erection of steel plate construction and castings.

New Developments

Arch Joists Basis of New Floor Construction

A self-contained arch joist carrying its own tie rod is the basis of a new floor construction known as the "Frease Arch Floor" as developed by the Structural Specialties Co., Canton, Ohio. Its several features include effective resistance to fire, adaptability to long spans, and the use of dome chambers, between the floors and the ceiling for receiving pipes, etc. The joists are available in spans up to 40 ft.

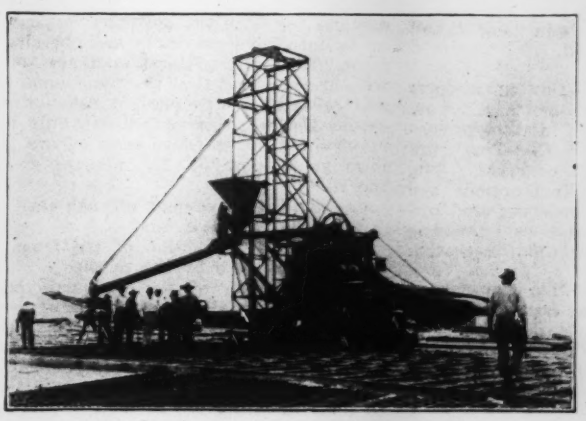
The accompanying illustration shows the details of the construction in a typical building using both arch floor and arch floor joists. The joists are made by riveting together I-beams and channels having their webs longitudinally cut on the diagonals. These form the tapered T arch-struts and the heel struts. For roof construction the upper surface of the triangular T-arch struts is sloped downward at each side of the central apex connection, thereby providing an economical self-draining roof construction. It will also be observed from the illustration that by suspending metal lath first below the joist tie rods and then below the arch struts no separate removable forms are required for placing the fireproofing concrete. The dome chambers between the floors and the ceiling may be made of any desired height for receiving and carrying any quantity of pipe, ducts, etc. It will be noted that there are no web members other than the heel struts, so that no obstructions occur in this domed space.



It is claimed that the same amount of concrete and the same amount of steel in Frease arch floors make a stronger floor than if used in ordinary flat slab concrete construction. Also all load-carrying members of the arch floors may be embedded in concrete.

Large Paver Equipped with Chuting Plant

A complete central mixing plant mounted on a 27-E paver is being used on seawall construction in Galveston. The paver is equipped with a special tower, elevating bucket and hopper for chuting the concrete from different locations. The Alamo Iron Works, representative of the T. L. Smith Co., Milwaukee, has furnished this outfit to J. W. Zempter & Co., Galveston. The extreme length of the causeway makes this portable outfit desirable. The boom and bucket ordinarily used on the paver have been removed but can be replaced at any time for road paving work.



Hydrogen Ion Values More Easily Found by New Apparatus

Hydrogen ion control is now recognized as one of the most important factors in the softening, coagulation and after-treatment of water. The introduction of an apparatus known as a roulette comparator and manufactured by the La Motte Chemical Products Co., Baltimore, Md., is claimed to have so simplified this control method that a plant foreman can make the determinations just as easily and accurately as a trained chemist.

The comparator consists essentially of a stationary base, a metal band, and a wooden drum which revolves inside the metal band on ball bearings. A block, which contains three slots, and which is drilled to hold three graduated test tubes, is fastened to the front of the metal band. A 40-watt electric lamp is fixed in the center of the base. Pieces of etched and "daylite" glass are fixed between the lamp and the front

of the test tube block. With this arrangement the observer always makes his readings under standard diffused daylight conditions, so that measurements made at night or in a dark place are just as accurate as those made during the day.

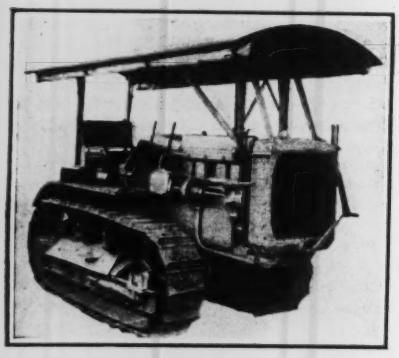
Three sets of color standards are supplied with the set: bromcresol purple, pH 5.2-6.8; bromthymol blue, 6.0-7.6; and phenol red, 6.8-8.4. In addition 27 ampoules of distilled water are included. An extra polished wooden case, containing 50-cc. bottles of the three corresponding indicator solutions, 1 empty 50-cc. bottle, four 0.5-cc. pipettes with nipples, and 18 graduated test tubes, are included as part of the equipment furnished with the comparator set.

In using the comparator, the three sets of color standards and ampoules of distilled water are placed in the holes in the revolving drum, the color standards alternating with ampoules

of water. Three of the test tubes are then filled to the mark (10 cc.) with the water to be tested and placed in the three holes in the block. Following this 0.5 cc. of the proper indicator solution is added to the middle tube and mixed thoroughly. The drum is revolved until the corresponding color standards are directly behind the test tubes; then the standards are slowly shifted by turning the drum until the color through the central test tube exactly matches one of the standards on either side of it, or else lies between them. The pH value is then read directly from the color standards. Since the pH ranges of the indicators overlap, it is usually possible to make determinations on a given sample with two different indicators and thus check the results obtained.

High Driver's Seat on Tractor Improves Driving Ease

Greater operative visibility and increased driving ease have been sought by the Caterpillar Tractor Co. in bring-



ing out a new model of its "Thirty" tractor with a high driver's seat. This tractor is now in production at the San Leandro, Calif., plant of the company. The lower-seated model will, however, still be produced.

New Publications

Pile Hammers—NATIONAL HOISTING ENGINE CO., Harrison, N. J., has issued a folder describing its pile hammers giving specification tables and illustrations of the hammers in use. A list of users is also included.

Bonding Material — CONCRETE SURFACE CORP., 342 Madison Ave., New York City, has issued a booklet describing its "Bonding Con-Tex" for bonding surfaces onto concrete. The material is described, instructions are given for specifying, ordering and applying the material, and its numerous uses are given, described and illustrated.

Centrifugal Pumps—LE COURTENAY CO., Newark, N. J., has issued two new bulletins 2012 and 2040 describing its centrifugal pumps. Illustrations of the different types and of machine details are given in addition to the text and a listing of parts.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Oct. 14, 1926	$13,598,000	$19,985,000	$33,583,000
Oct. 7, 1926	22,513,000	52,162,000	74,675,000
Oct. 15, 1925	9,731,000	21,413,000	31,144,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	888,771,000	1,397,812,000	2,286,583,000
1925	862,419,000	1,169,288,000	2,031,707,000

Sand, Stone, Gravel and Steel Shippers Warned of Car Shortage

Freight loadings have been running well over a million cars per week, during the last four months or more. There are practically no surplus cars with which to meet the anticipated heavy loading period of this month and next according to Railway authorities. In view of this situation, attention is drawn to the following excerpt from a letter by M. J. Gormley, chairman of the American Railway Association, to members of advisory boards, shippers, receivers, and the public generally:

"The supply of surplus serviceable freight cars is practically exhausted. This condition is particularly marked in the case of open top cars, the average daily surplus of which is now only 33,039 cars, a figure less than half an average day's loading of this class of equipment. The loading of commodities usually handled in open top cars, particularly ore, sand, stone, gravel, steel products, etc., is much heavier than ever before. In spite of the extraordinary demand for open top cars the railroads up to date have generally met the situation practically without shortage, but with the prospect that the requirements will continue at the present rate, or in excess thereof, this record can only be maintained by extraordinary efforts to improve, if possible, the present good record:

1st—In the movement of such cars by the railroads, and

2nd—In the reduction of the time cars are held by the public.

The attention of the railroads has been called to the importance of the first item, and the purpose of this letter is to appeal to the members of the Advisory Boards and shippers generally to assist, by giving special attention to their handling of these cars, especially for the next sixty days—

1st—By unloading cars within the free time, and within the first day of placement, if possible;

2nd—By not ordering cars in excess of immediate requirements.

Let the slogan 'No Demurrage Accruals During October and November, 1926' be adopted by every shipper and receiver in the country.

With this program worked out successfully through joint cooperation on the part of the shippers and the railroads it can be stated as a positive fact that there will be no shortage of cars experienced during the anticipated heavy loading period of the next two months."

Unit Prices of Materials in Place

Pavement

The following unit costs (materials plus labor) are included in the low bidders estimates on various concrete paving jobs, 1922 to date:

Location	Date	Sq.Yd.	Price
Mo. State Highway	Sept., 1922	51,741	$2 40
Utah State Highway	Oct., 1922	43,238	1 15
St. Louis, Mo.	Nov., 1922	25,550	3.25
Laredo, Tex.	Mar., 1923	120,062	2 58
Baltimore, Md.	Apr., 1923	24,500	3.25
Va. State Highway	Nov., 1923	51,683	3 15
Chicago, Ill.	Mar., 1926	1,750	4.00

The following unit costs (materials plus labor) are included in the low bidders estimates on sheet asphalt and bituminous concrete paving jobs in various parts of the country:

Location	Date	Sq.yd.	Price per Sq.yd.
Sheet asphalt, Akron, O.	Sept., 1922	10,700	$1.70
Bituminous concrete, Ore. State Highway	Mar., 1923	1,000	1.50
Bituminous concrete, New York, N. Y.	Jan., 1924	10,000	1.75
Sheet asphalt, Brooklyn, N. Y.	Feb., 1924	11,000	2.00
Bituminous concrete, Topeka, Kan.	May, 1925	58,597	2.45

Industry Builds on a New Plane Since the War

Despite overbuilding in the war years and until 1921, American industry is now going ahead with actual physical expansion of plant at the rate of 140 per cent compared with 1913 and 1914. A new plane of production calls for a faster and wider scheme of distribution. Production is now geared up to meet ordinary demand easily and shouts for sound salesmanship to increase markets.

THE amount and value of contracts awarded for industrial building is a very important barometer in indicating the general condition of business. The reason, therefore, of making a study of this branch of the construction industry is obvious. The figures used are *Engineering News-Record* statistics of contracts for industrial buildings to cost $40,000 or more.

One is confronted by many problems, the answers to which are not always clear, due to the limitations of the statistical data which are not available further back than 1913, giving us only thirteen and a half years on which to base our conclusions. This in itself is a small number, but when we add to that the consideration that the war years threw everything out of joint, disturbing the normal rate of growth and probably lifting us on to an entirely new plane of industrial activity, it is no wonder that we must hedge our conclusions with "ifs" and "buts." We hope, however, that in the future we not only will have more comprehensive statistics but also that there will be no war or world-wide earthquake to disturb the statistician's peace of mind.

A search for the elusive *normal growth line* led us to substitute quarterly figures for the monthly ones whose nature was so highly erratic that they only obscured the problem. The next step was to take the money value of contracts awarded and deflate them to 1913 purchasing value by means of the *Engineering News-Record* cost index number. This would have a truer relation to the physical amount of industrial building. In spite of all this refining the 1913 figures remain about 45 per cent and the 1914 figures about 40 per cent below the normal for the later years. Although no figures for previous years can be found for the purpose of comparison, there is no reason to believe that these two years were so far below normal. It would be quite safe to assume that the war gave a tremendous impetus to industrial activity and that there was a real break in the rate of growth.

The first chart shows the actual value of contracts awarded by quarters from 1913 to 1926. The second chart is the result after the refining processes, i.e., after deflating to 1913 purchasing basis and reducing to the percentage deviations from the normal growth line. The seasonal influences have not been eliminated because of an apparent change since the war which can not as yet be measured with any great reliability. From 1913 to 1918 there seems to be a pronounced peak in the summer months, June, July and August. Since that time no regular seasonal tendency in the data at hand can be discerned, although in several instances there is an increase in the spring and fall above the rest of the year. But whether this is a true seasonal fluctuation or a matter of accident it is still too soon to say with any certainty.

The dotted line on Chart II is the index of the physical volume of production compiled by the Federal Reserve Board. In a normal economic system there should be a rather high correlation between the amount of goods produced and the amount of industrial building. A closer look at the chart bears out this assumption to a certain extent. The rise in production in 1915 and 1916 was accompanied by a tremendous increase in industrial building which undoubtedly was a period of over-building, as it is followed by a slump in the early part of 1917. In 1918 the production continoues high and the building, although distributed unevenly over the year, is on the average well above normal. In 1919 we have another big increase in building which seems unwarranted by the volume of production. It is only to be expected that it is followed by an equally big slump. From there on, the building curve shows a more sensitive relation to the production curve which is indicative of good sense and conservatism in business.

The fact that a great many industrial plants built during the over-production in 1920 are now being pressed into service probably accounts for the industrial building curve running somewhat lower than might be expected from the great increase in production since 1923.

At any rate, in a few more years when we have more homogeneous material to work from, we may be able to derive a workable prediction formula.

For the present we have to content ourselves with results that only show the way the wind blows. But even this can be a most valuable guide to the wise business man.

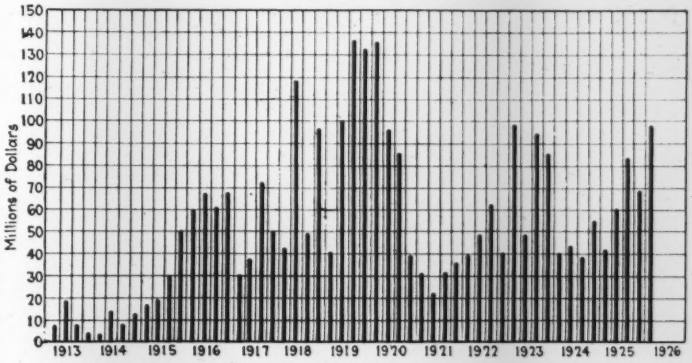


CHART I—MONEY VALUE OF CONTRACTS FOR INDUSTRIAL BUILDINGS OF $40,000 AND MORE AS REPORTED BY ENGINEERING NEWS-RECORD

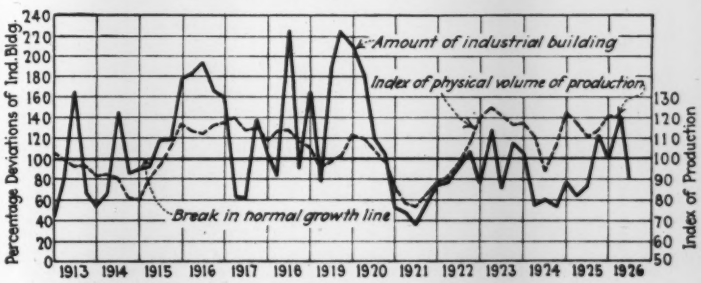


CHART II—INDUSTRIAL BUILDING CONTRACTS DEFLATED AND COMPARED WITH INDUSTRIAL PRODUCTION

IN PREPARATION—A study of costs in a specific office building in 1914 and in 1925. Labor and materials considered separately.

Weekly Construction Market

ADVANCES outnumber declines in the current building materials market, contrary to the seasonal movement of prices in this group.

Firmness with upward tendency is noted in structural rivets, wrought steel pipe, gravel, pine timbers and hollow building tile in Western and Southern points.

Mill prices of sewer pipe are substantially above the September levels in sizes 3-in. to 36-in., with the possible exception of 27-in. and 30-in.

Cast-iron pipe dropped $1 per ton in New York and Chicago during the last month, while linseed oil shows a steady downward tendency in New York, Dallas, Chicago, Denver and Minneapolis. The Montreal market, contrary to the linseed oil situation in the States, went up 2c. per gal. (7½ lb.) since last week.

Lime prices show some fluctuation but without definite direction.

Reinforcing bars are quoted in most price tables at $2.60 per 100 lb., in carload lots, f.o.b. Chicago. Recently, a quantity as small as 200 tons went at $2.10 per 100 lb. The market may, therefore, be said to range from $2.25 to $2.40 per 100 lb. in carload lots, f.o.b. Chicago warehouses.

Steel is steady at present and non-ferrous metals slow. Structurals and reinforcing bars hold firmly to $2 per 100 lb. f.o.b. Pittsburgh mill in large tonnages.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb.	4.20	3.80	+4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	3.38	—2.25@2.40	2.87½	3.77½	2.95	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	+53.6%	51%	54.25%	41%	49.7@54.1%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	—51.60@52.60	45.25	54.00	—48.20	53.00	64.00	50.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	+2.38	1.60	1.65	1.90	1.80	1.50	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	34.00	56.00	+58.25	38.25	34.75	27.00	23.00	50.00
Lime, finishing, hydrated, ton	18.20	23.50	—19.00	20.00	25.50	24.00	+25.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@3.00	1.50	—1.82	—1.50	1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	+ 088	.076	.075	.....	.09	.10
Hollow partition tile 4x12x12, per block	.1112	.0895	.112	+ 088	.076	.075	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	—.85½	.99¾	—1.10	—.88	—.94½	—1.08	1.01	1.12	+1.05
Common Labor									
Common labor, union, hour	.90⅜	.30	.....	+ 90	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	30@.50	82½	45@.60	.40@.45	.50	.50	1.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06¼; building laborers, 90⅜c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Oct. 7 the next on Nov. 4.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.156). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Business Briefs

Call money quoted at 4@5½ per cent, week of Oct. 6; year ago 4½@5½ per cent.

Time loans: Week of Oct. 4, 5@5½ per cent; year ago, 4½@5.

Commercial paper: Week of Oct. 4, 4½@4¾; year ago, same rate.

On Oct. 1, 1926

E. N.-R. Construction Cost Index Number 209.80

E. N.-R. Construction Volume Index Number 227

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month